MODERN Machine Shop

HOWARD CAMPBELL, Editor

Volume 6 NOVEMBER, 1933 • Number 6

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MODERN Machine Shop

NOVEMBER, 1933

CINCINNATI, OHIO VOL. 6, NO. 6

Diffraction Patterns Reveal Crystalline Structure of Metals

BY WILLIAM G. PRAED

Radiologist, Claud S. Gordon Laboratories

THE use of the X-ray in industry is constantly increasing, and industrial executives are discovering that by this means it is possible to discover solutions to many problems which cannot be solved satisfactorily in any other manner. It is more or less commonly known now, at least to those who keep abreast of the times, that the X-ray makes it possible to discover the crystalline structure; that is, the manner in which the crystals lie in relation to each other, in a piece of metal. And with this information, an experienced radiologist can readily determine the condition of the metal.

One of the greatest aids to industry, today, is the microscope with its variety of uses and applications. In one of these applications the microscope is combined with the camera to produce the photomicrograph, which has been of unlimited value in determining the manner in which carbon combines with other elements in the formation of metals and in determining the condition of those elements. The X-ray diffraction pattern, however, shows the structure of the metal in the interior of the section; not alone on the surface. At the same time, it would be a mistake to assume that the diffraction pattern will replace the photomicrograph; rather, it will supplement and augment the information obtained by the photomicrographic method, although the photomicrograph reveals the structure only at the surface. The diffraction pat-

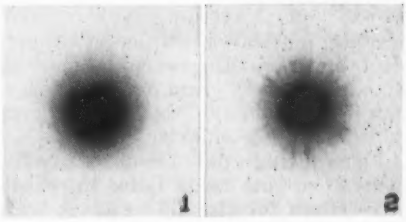
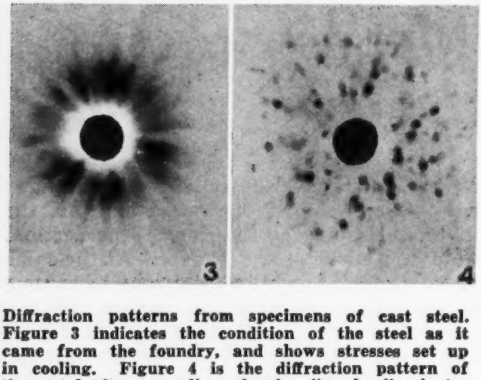


Fig. 1—The even, unlined appearance of the pattern indicates a fine crystalline structure, free from strains. Fig. 2—This pattern shows a strained condition, with distorted crystals. This metal was much harder to machine than that represented by the pattern shown in Fig. 1.

tern reveals characteristics which can be obtained by no other method.

The place of the X-ray diffraction pattern in metallurgy may be illustrated by the following case. The attention of the metallurgist and the superintendent of a certain concern was called to a problem in which two different heats of steel of the same analysis were involved. It seemed that when the two lots of steel were given the same treatment, for the same purpose, one lot showed a higher Brinell reading and machined more readily than the other. The second lot showed a lower Brinell reading, was very much more difficult to machine, and dulled the tools quickly.



Diffraction patterns from specimens of cast steel. Figure 3 indicates the condition of the steel as it came from the foundry, and shows stresses set up in cooling. Figure 4 is the diffraction pattern of the metal after annealing, showing "random" orientation of the crystals.

Photomicrographs taken of specimens from both heats failed to reveal any reason for the difference in machining qualities, and apparently they were up against a problem for which there was no answer. Then someone suggested the X-ray laboratory.

A specimen from each heat was submitted for a study of the crystalline structure by diffraction patterns. The diffraction pattern of the specimen giving the higher Brinell reading is shown in Fig. 1. The even, unlined appearance of the pattern indicates a fine crystalline structure, free from strains and of good, homogeneous material. Figure 2 shows the diffraction pattern taken from a specimen from the second lot of steel. The illustration clearly shows a striated, strained condition, with the crystals distorted, and it is easy to see why the metal from which this sample was taken was so much harder to machine than the first specimen.

When the superintendent saw the patterns and realized that his problem was solved, he was as tickled as a boy with his first long pants. He realized that while some extra processing might be involved, finding the difficulty was half the battle and the diffraction pattern would make it possible for him to know when his material was uniform.

For the metallurgist, however, the job was only half completed. Having identified the condition that was responsible for the difficult machineability, the next step consisted in tracing the cause. Was the steel over-rolled? Or was it rolled in a chilled condition? Will this difficulty occur again?

If this matter were followed back to the mills, and the mills realized that the customer was using the most modern scientific method for inspection of their product, they would soon get their research and metallurgical departments on the job. But while the conditions described above are allowed to continue to exist, we jeopardize our chances for obtaining more uniform materials and for improving our own methods and product.

Research, development and metallurgical departments are frequently looked upon by the management as necessary evils—an attitude that is unquestionably wrong. The metallur-

gical chemist is too often shut into a laboratory that is entirely separated from both the office and the plant, and in many cases is considered only as a first aid in emergency instead of being looked to in an advisory and research capacity. Too many plant

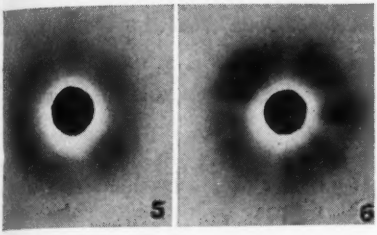


Fig. 5—Diffraction pattern of the metal adjacent to the fracture of the test bar from which the pattern shown in Fig. 3 was taken. Fig. 6—Pattern of the metal in the fracture in the test bar from which the pattern Fig. 4 was taken. These patterns show that the slightest change in the structure is reflected in the patterns.

managers are prone to concern themselves with the phases of industry with which they are familiar and which are apparent to the eye, and are inclined to overlook that fact that—given the opportunity—the research laboratory may point the way to better results, higher production, and lower manufacturing costs.

In addition to the illustrations Fig. 1 and Fig. 2, referred to above, diffraction patterns from specimens of cast steel, from zinc alloy, and from a weld are shown. In Figs. 3 and 4 are shown diffraction patterns from specimens of cast steel. We were told that, from some test standpoints, the specimens were about even; that is they were alike in tensile strength, elongation, and reduction or area. However, in the impact test, there was no comparison. We were also told that there was very little difference in the grain size when examined under the microscope.

The condition of the steel as it came from the foundry is indicated by the pattern Fig. 3. The heavy lines, or striae, radiating from the center indicate a strained condition with the crystals distorted. The metallurgist explained that the castings in this particular lot answered his purpose, and he wanted to find the best way to examine the crystalline structure and standardize upon it. Figure 4 shows the diffraction pattern of an annealed casting. The structure indicates a random orientation, which means the crystals are "at ease"; that is, all strains are removed. This piece is now ready to receive the treatment for its particular purpose.

That there would be a great difference in the impact resistance of the two specimens is obvious. While the pattern Fig. 3 shows strains, yet the crystals are oriented so as to resist impact. The random orientation of the crystals in the pattern Fig. 4 show that there is no bond and thus they are unable to resist impact. To prop-

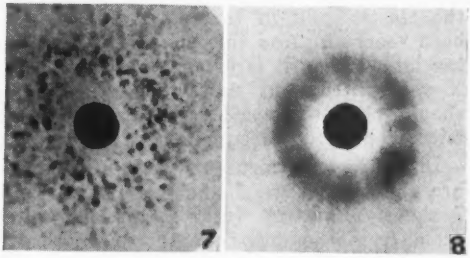
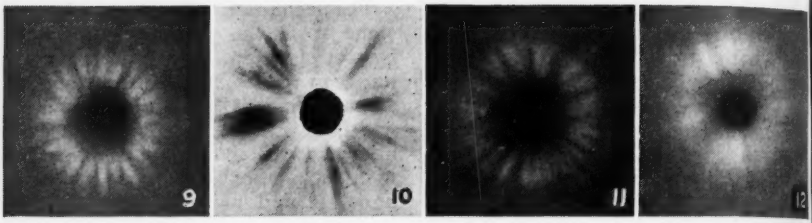


Fig. 7 and 8—Diffraction patterns of zinc alloy. Fig. 7 was taken from annealed zinc and Fig. 8 shows a pattern from a much harder specimen of the same material.

erly condition this piece, it would have to be treated.

Diffraction patterns of specimens taken from the test bars Fig. 3 and Fig. 4 are shown in Figs. 5 and 6. The specimens were taken from points near the fractures obtained during



These diffraction patterns were taken from a weld and show; Fig. 9, the condition of the crystals in the parent metal; Fig. 10, pattern of the deposited metal in the weld; Fig. 11, the parent metal adjacent to the weld, and, Fig. 12, the metal in the weld after stresses have been relieved.

tests for tensile strength, and show how the crystals oriented during these tests in an effort to adjust themselves to the strain being put upon them. Fig. 5 is from the test bar from which the pattern Fig. 3 was taken, and Fig. 6 is from the bar from which the pattern Fig. 4 was taken. These patterns illustrate the fact that diffraction patterns will always show the slightest change in the crystalline structure of metals. The microscope, on the other hand, will show the difference in grain size, but no strains can be detected until the elastic limit of the material has been reached. And this, of course, is too late. Thus it is evident that the X-ray diffraction pattern method should be used—not to displace the microscope—but to supplement it.

Diffraction patterns of zinc alloy are shown in Figs. 7 and 8. Figure 7 shows a pattern from metal that came from the mill in a thoroughly annealed condition, and was considered good material. The other pattern, Fig. 8, was made from a specimen taken from much harder material of the same kind, and shows a difference in the arrangement of the crystals.

The difference in patterns is considerable. The orientation in the pattern Fig. 8 shows strains throughout, although, according to the engineer who was having the tests made, this condition might possibly indicate the result desired. In this case, again, the microscope failed to show a difference that could be depended upon as a basis for identification for uniformity, even though each step in the manufacturing process was carefully checked.

The four diffraction patterns Figs. 9, 10, 11 and 12 are taken from a weld and show the condition of the crystals in the parent metal, the deposited metal in the weld, the parent metal adjacent to the weld, and the deposited metal after the weld has been stress-relieved. In pressure vessels there is a constant readjustment of the crystals in the metal due to the expansion and contraction that result from constant heating and cooling, and regardless of how good the welds are, there is always considerable stress set up in the deposited metal area which forms the weld proper.

This stress should be relieved to insure permanency to the weld and to bring about a condition in the welded area that will be at least equal to the quality, strength, and other characteristics of the parent metal. By taking the necessary measures to relieve the stress, the possibility of the development of corrosive action in the weld is eliminated, insuring safety.

The diffraction pattern of the par-

(Continued on page 26)

MONARCH ANNOUNCES

FOR years, some of the largest users of hand feed precision surface grinding machines have wanted a new grinder that would incorporate certain advanced features that their years of practical experience indicated as being desirable. Working closely with Monarch engineers, they assisted in the development of the new Monarch Hand Feed Precision Surface Grinding Machine.

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SMOOTHER..QUIETER..MORE POWERFUL

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1. **Direct motor connected in-built anti-friction bearing spindle unit . . . built by the Ex-Cell-O Aircraft & Tool Corporation.**
2. **Automatic force feed lubrication to all bearing surfaces except spindle bearings.**
3. **Adjustable roller chain and sprocket for length table traverse, eliminating rack and pinion tooth marks on work, preventing back lash and giving absolute smoothness to length table travel.**
4. **Adjustable nut on spindle elevating screw to compensate for wear and eliminate back lash.**
5. **Spindle elevating hand wheel graduated in .0005", thus insuring extremely accurate setting.**
6. **Machine is easily and quickly operated. Strength and rigidity of all parts together with spindle construction and perfect lubrication facilities insure lasting accuracy in the machine, and as near perfect grinding results as have been secured thus far.**

Write for literature

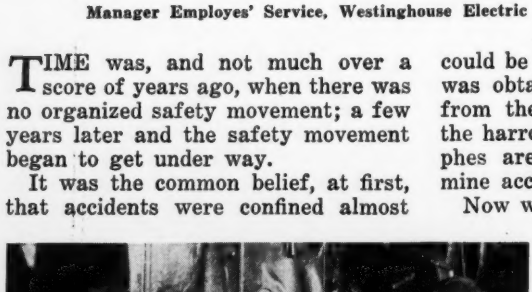
Safety Devices in the Modern Safety Program

*By C. B. Auel,

Manager Employes' Service, Westinghouse Electric & Manufacturing Company

TIME was, and not much over a score of years ago, when there was no organized safety movement; a few years later and the safety movement began to get under way.

It was the common belief, at first, that accidents were confined almost entirely to the industries, and that their prevention was almost wholly a matter of placing mechanical guards around machines. It was even appreciated that devising such guards would in some instances be a difficult matter, but barring exceptions, when equipment had been so guarded, it was expected that accidents would cease.



A modified two-handed guard on a punch press. Both handles must be moved before machine can be operated.

Why was there ever such a series of mistaken notions as these?

Simply because there were no statistics available from which the facts could be gleaned, such information as was obtainable being gleaned largely from the daily press, in which only the harrowing accidents and catastrophes are reported—not the run-of-mine accidents.

Now we know, years later and both from statistics and from our own varied experiences, bought at a tremendous price, that what we thought was the solution of the entire problem of accident prevention; namely, mechanical guards, is but a small part, while other preventatives, some of which are most odd in kind, already play or are commencing to play their parts as well. Included among these preventatives are:

Minimum labor turnover
Good health
Contentment
Neatness
Cleanliness
Understanding of English
Good lighting
Wearing apparel
Education
X-ray apparatus
Air conditioning apparatus
Photo-electric cells

Most of these may, in one sense, be called guards so that if we were to

*Address presented before the National Safety Council Convention, Chicago, October 3, 1933.

drop the word "mechanical" in connection with guards and broaden our ideas as to what constitutes a guard, we could almost revert to our original conception of the solution of the accident prevention problem and still say it is largely a matter of guarding.

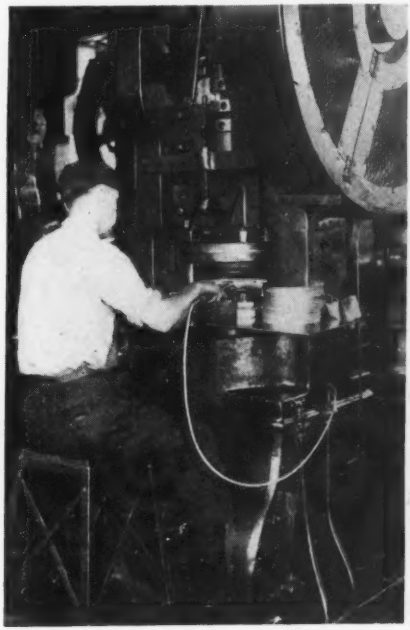
Let us advance a step further, however, and cease looking upon guards or preventives against injury simply as negative devices, but rather let us look upon them as something even more valuable:—namely, as positive devices, aids to safety and also to production and as devices to permit more nearly normal functioning of the worker, even if at times they aid in these several other respects only indirectly.

But indirect effects, though often incapable of measurement, have their value; in fact, the speaker is inclined to the belief that "indirect effects" in accident prevention are worthy of more careful study than they have heretofore received.

Who is there to deny that light, besides enabling work to be better seen and done, hazards observed and accidents therefore avoided, also adds cheer to a place; that neatness and cleanliness, involving the removal of dirt and obstructions, produce a feeling of comfort among the workers; that safe working conditions relieve or obviate mental strain; that good health is a distinct asset to every worker.

These are intangible effects as far as our present means of measurement go, but of real value nevertheless in accident prevention work, for they add to the ease, contentment and well-being and, therefore, to the more normal performance of the workers, resulting in an increase in the morals of the entire establishment.

There is a further intangible effect of safe-guards applicable particularly to mechanical and other direct forms of guarding, and that is their educational value, for they speak almost as loudly as such signs as "Safety First," and thus go a long way toward convincing the workers that the management is backing the safety movement in the plant. This is one of the reasons why all guards, signs,



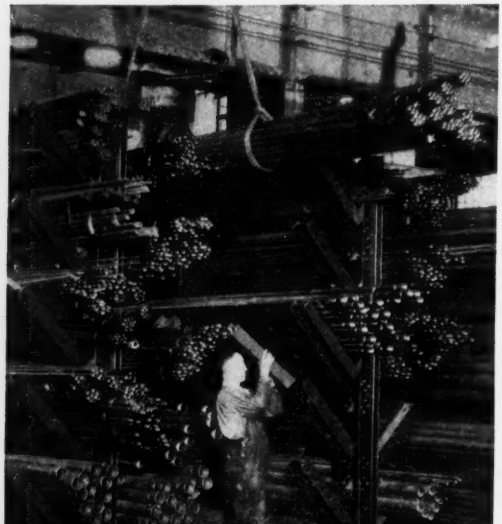
A suction pad, operated by air, allows the operator to remove the stampings without placing his hands in the danger zone.

and so on, should always be kept in first class shape and freshly painted, and one of the reasons why safety inspections are worth while.

With reference to mechanical guards, in the design of tools and equipment and in the development of processes, effort should be made to avoid the necessity of the operators having to use guards at all or to take precautions against accident, thus making the equipment absolutely

fool-proof and eliminating the possibility of accident in the event of human failure.

Failing this, the next best type of guard is one that does not permit the operator to enter the danger zone with any part of his body.



Extension arms make it possible for the crane to load and unload directly onto the pipe and bar racks. As the load strikes the extension arms, it slides down into place and the arms are then removed.

And the next best type of guard is one that prevents the machine from functioning until the danger zone is cleared of obstruction; that is, a guard that must be in the fully closed position before the machine can operate. A gate guard on a punch press is of this type.

Finally we come to the type of guard where some degree of cooperation is required on the part of the operator if accident is to be avoided.

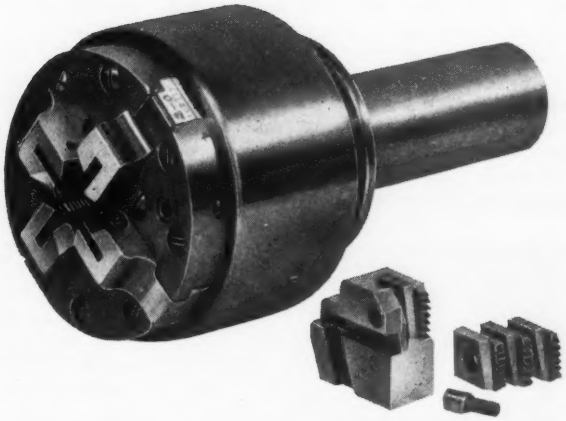
When purchasing machine tools or equipment, it is well to include in the specifications a clause to the effect that, other things being equal, preference will be given to the best guarded designs; or better yet, include exact specifications for guarding and thus avoid misunderstandings. But if, upon arrival, the tools or equipment are found not to conform to the requirements of safety, there should be no hesitation in insisting upon the supplier making such changes as may be necessary or else doing the work one's self and charging the cost back to him.

While many concerns do much of their own guarding because of the special features connected with it, commercial guards should be purchased wherever possible. Commercial guards are built to fill the needs arising from many sources, so that in purchasing them, one purchases experience beyond one's own limited sphere and it is not only fair but common sense, therefore, to patronize the guard manufacturer who is rendering service of the highest value—the saving of life and limb, and the prevention of waste.

The ideas of the workers regarding safety should also be sought, and for this reason among others a suggestion system can often be installed to advantage, either permanently or during a safety drive.

To maintain safety equipment and standards at their proper effectiveness, a special system of inspection must be provided to include them, aside from any general system of departmental inspection or patrol. After considerable study by our own company, no better way has as yet been devised for looking after certain of

Lower Threading Costs This New Way



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(The operator's dream come true)

No Chaser Grinding - Reduced Set-up Time

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6. Low inventory investment.
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8. Longer production runs before getting dull.
9. Chasers may be used in different die head sizes.
10. Reduces thread cutting to its simplest form.

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(Patents pending on die head and its parts.)

THE EASTERN MACHINE SCREW CORP.

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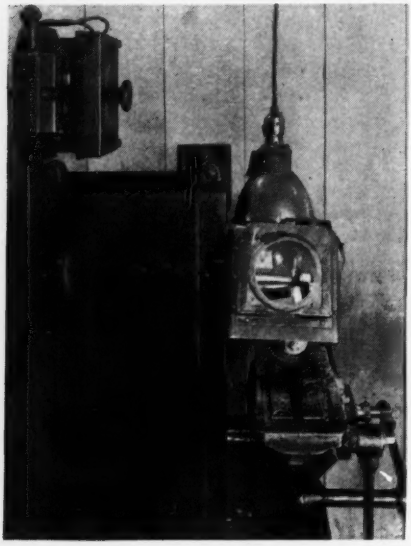
Manufacturers of the H & G Self Opening Die Heads

our equipment and standards than our so-called safety calendar, a sheet which is divided into as many spaces as are deemed necessary to record our inspection periods. In these spaces are listed such items or matters as are inspected or looked after at the intervals named: elevators, daily; hand trucks and portable ladders,



A simple but effective guard on a hand milling job. The large magnifying glass not only protects the eyes of the operator from flying particles, but also helps him to produce more accurate work.

quarterly; medical examinations, semi-annually, and so on.

However, these inspections do not cover all requirements and so at intervals we, therefore, inspect departments to see if goggles, helmets, gloves, armlets and other devices are being sterilized and repaired before being reissued. We also ascertain if gauges and thermometers continue to be checked; if the air flow is right at spray booths and sand blasts; and if any unlooked-for hazards have developed or if unsafe practices are being indulged in by the workers.

X-ray, blood and urine examinations might also be included among modern safety devices, for they serve as warning signals if used in examining operators who work where dust or fumes are prevalent.

Without periodical attention, safety devices and standards, like anything else, will deteriorate and may be found wanting in time of emergency and may receive blame to which they are by no means entitled.

If we accept the tabulated statements of five States for one year as published in Accident Facts, 1933 edition, of the National Safety Council, as being typical of the entire country, then accidents in the industries may be divided into the following classes:

	No.	P'cent
Handling objects	58249	25.9
Falls to a different level	19616	18.2
Falls to the same level	21426	18.2
Machinery	26884	11.7
Vehicles	24569	10.9
Falling objects	19572	8.7
Using hand tools	17050	7.5
Stepping on or striking objects	12552	5.5
Electricity, explosions, heat	8021	3.5
Harmful substances	4607	2.5
Other	12115	5.3
Total	224661	99.7

It is seen from these figures that handling objects constitutes by far the largest single cause of industrial accidents—and curiously they are accidents away from machines.

This would seem to indicate, therefore, that mechanical handling should be substituted as much as possible for handling by hand. Among the more important safety devices for this work should, therefore, be listed mechanical feeding, conveyors, trucks, cranes, hoists and the like. Some-

SAFETY INSPECTION CALENDAR

CONTINUOUSLY

Cranes and Slings
Dip Tanks
Electric Trucks—Hand Trucks
Elevators
Eye and Foot Protection
Fire Equipment
Floors—Loose Boards—Holes—Slippery
Industrial Cars
Industrial Heating and Ventilating
Ladders—All Types
Lighting and Electrical Equipment
Pressure Gauges
Railway and Equipment
Respirators—Wearing of
Sanitation
Spray Booths
Thermometers
Traffic Lines
Walks—In Buildings and Yards

ANNUALLY

Chauffeurs
Crane Operators
Hookers On
Railway Operating Force

SEMI-ANNUALLY

Belt Lacings
Electrical Hazards
Employes Working on Live Circuits
Firemen and Fire Drills
Food Handlers
Gas Masks
Mushroom Tools
Overhead Walks
Safety Cans
Stair Treads and Railings
Window Cleaners Belts
Window Hooks

QUARTERLY

Air Lines
Gasoline Torches
Grinding Wheels—Lights and Water Tanks
Painters—Using Spray Guns
Solder Pots
Sterilizing Outfits for Goggles—Etc.
Warning Signs

MONTHLY

Acetylene and Electric Welding Outfits
Flood Gates
High Speed Saws—Used on Metal
Punch Press Trips
Safety Meeting
Ventilating Pipes
Welders—Examination of Eyes
Workers Using Litharge

WEEKLY

Bulletin Boards
Stretcher Cabinets

Westinghouse Safety Inspection Calendar

times a re-routing of material through the manufacturing departments or a change in the sequence of operations may reduce the amount of handling, and occasionally gloves or wearing apparel may be the cause of an accident.

The next largest number of accidents is caused by falling; thus another group of safety devices is indicated as the solution for accidents of this nature, such as ladders, railings, platforms, plant cleanliness, neatness, and good lighting. Regarding the accidents due to falling objects; the wearing of safety shoes would probably have reduced the number of reportable accidents and there is no reason why safety shoes should not be universally worn.

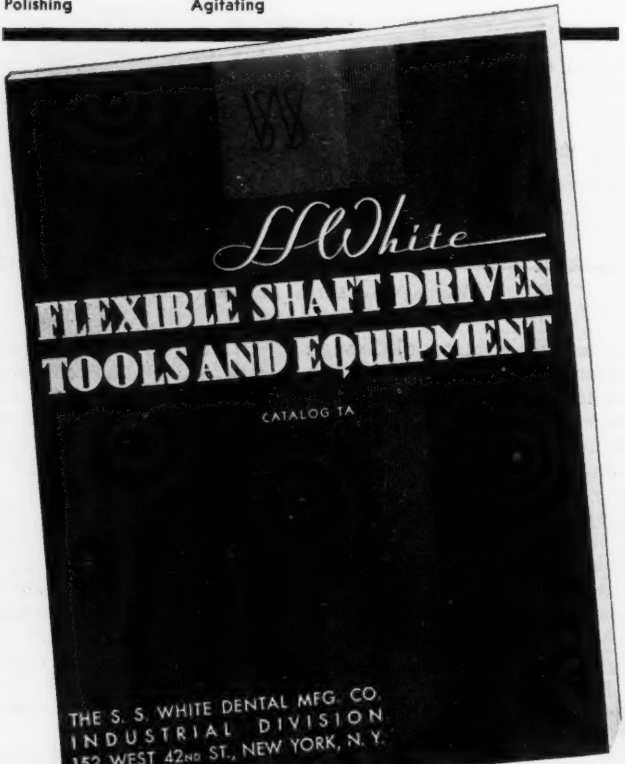
A large number of the accidents due to defective hand tools could undoubtedly be avoided by the elimination of mushroomed chisels, loose hammerheads, by the use of the right tools in the right place, and by the use of goggles and screens.

Notwithstanding the fact that many accidents are due to machinery, we still continue to urge the further use of machinery to reduce accidents as indicated by our recommendations under "accidents due to handling objects." Engineering revision too may be counted on year by year to assist in this work by the production of foolproof designs.

In our plant we physically examine at regular intervals all of our men, from the designing engineers to the

A few general applications of S. S. W. CUTTING and GRINDING TOOLS and OUTFITS

Die-sinking	Burring	Erasing
Drilling	Engraving	Paint Scraping
Boring	Chasing	Trimming
Reaming	Carving	Skinning Wire
Milling	Cutting	Repair Work
Grinding	Sharpening	
Lapping	Assembling	
Polishing	Agitating	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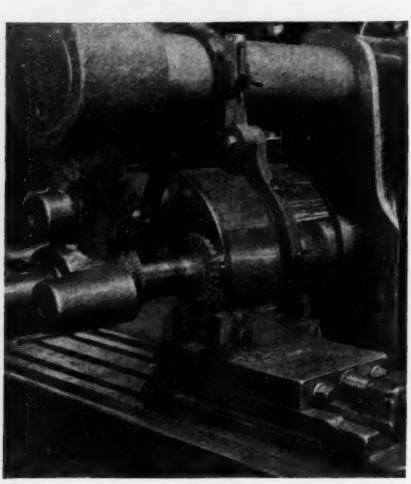
wiremen, if their work involves any handling of live electrical circuits, for we have found that over the years several of our men have succumbed to shocks which, had they been in normal physical condition, would hardly have caused disability or would at least have responded to the prone pressure method of resuscitation. Members of our fire department are included in this examination.

Reference already has been made briefly to the matter of lighting, but it is of such importance, having as it does an influence on so many of the causes of accident mentioned here, that further reference to it is warranted.

Dr. LeGrand H. Hardy, Director of Eye Service in the Fifth Avenue Hospital, New York City, has stated that of 50,000,000 incandescent lamps installed in our industrial plants, less than 25 per cent are so installed that they will not produce glare. He makes the further statement that 15 per cent of industrial accidents are caused by poor lighting, with an annual direct cost to employers of $150,000,000.

Many workmen were cut by the sharp corners of the sheet stock before this guard was placed here. Now the men cannot get close enough to cut themselves.



On a high-speed milling job, a guard like this one will protect the operator and others in the vicinity from flying particles.

How much of this is due either in whole or in part to defects in vision of the workers is not possible to state, but it must be an appreciable amount when estimates have been made that 40 per cent of the industrial workers suffer from defective vision or ocular defects.

Good lighting, however, is exceedingly cheap, for it can be shown that if a worker increases his output by only 2 to 3 minutes per day, either due to better vision, fewer delays or less spoilage, the cost of good lighting will pay for itself, and as this fact becomes better known more attention will be given to the subject.

Many states have developed excellent safety standards, although they are not all alike, and it is equally true that other states have made little headway. Just as the lack of statis-

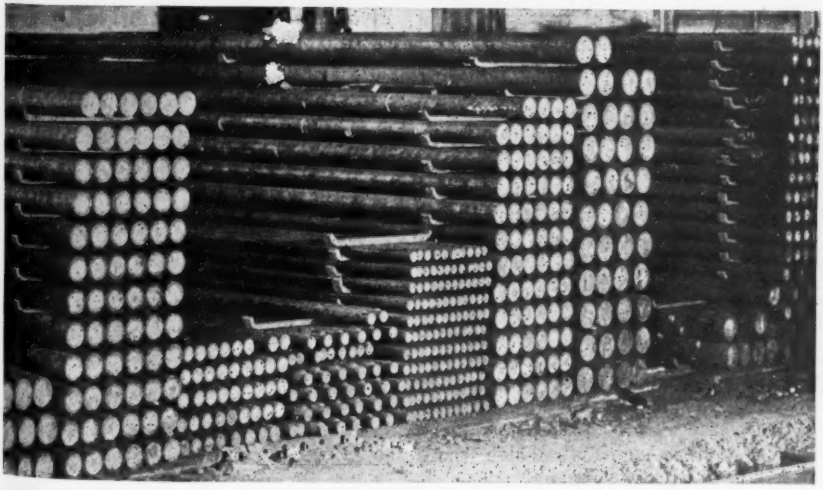
tics was originally a most heavy handicap to the safety movement, so now the present lack of uniformity in safety standards as well as in statistics is a serious hindrance to its more rapid headway, and the various states should, therefore, endeavor to concentrate and agree on these matters of statistics and standards.

Since the national government is giving codes to various industries, why not standardize nationally both safety statistics and safety codes and, if not expecting too much, compensation.

Notwithstanding the great diversity of signs pertaining to safety already on the market, it is believed a further wide application for these may be found. It is suggested that they be used much after the manner of the Red Cross and other activities and, more recently, the NRA signs, to enroll workers for various purposes such as: those who have never had an accident; those who have gone five years without an accident, and so on, giving to each a high grade sign and fastening it to his machine in a prominent place or on a standard at his work bench. A plan we have adopted in our own plants has been to list occupations or jobs at which goggles should be worn, then to provide each worker who promises to campaign in our drive against eye accidents with a handsome sign of suitable size for his machine or work bench and with the wording: "Eyes protected on this job—operator wears goggles."

Notwithstanding all of the progress made in the prevention of accidents through the development of safety devices and standards, as well as by educational methods, the speaker is convinced that an increase, even small, in the standard of health over the country would do more than any other one thing to reduce accidents.

In conclusion, safety devices are always going to play their part in the work of accident prevention, and the list of such items will become constantly larger and more diversified as time goes on.



In piling round bar stock, metal strips that have been turned up on the ends are used. The strips add to the neatness and prevent bars from rolling off the piles.

Notes on the Maintenance of Electric Motors

With the resumption of production schedules, power is being applied to thousands of electric motors that have been standing idle for many months. Proper attention now may save a lot of expense and trouble later.

By Ernest W. Fair

THE electric motor is a faithful servant; it will strain with its last ounce of energy to pull the load to which it is harnessed; it will struggle against the handicaps of a worn commutator, worn brushes, worn bearings, inadequate lubrication, and dirty coils until a cloud of smoke and the odor of burning insulation announces that it has given up the ghost. To force a motor to continue in operation under such conditions is—in every sense of the word—bad business; such disregard of a fine piece of machinery will not only mean costly repairs to the motor, but it may be responsible for an expensive shut-down at a critical moment.

The last couple of months have seen a gradual resumption of production schedules. Plants and departments that have been standing idle are showing signs of life. The necessity for parts has forced the starting up of machines, the power for which is, in 99 per cent of the cases, supplied through electric motors. The production machines are usually cleaned and oiled before they are put into service, but unfortunately this same care is not always given to the motors—without which there would be no production.

Strict maintenance standards are particularly necessary in the modern machine shop where high speeds, strains, and stresses of various kinds can bring about costly repairs, and where even improper alignment of the shafting may easily damage expensive machines.

Primarily, the location of the motor should be studied. It should be protected from moisture, steam, oil, acid, alkali, and any form of liquid or gas. It should also be protected from dust, should be well ventilated, and should be so placed as to be easily accessible for cleaning and inspection. Foreign materials of any kind—even dust in large quantities—in the motor armature will be likely to ruin it. After the location has been decided upon and the motor has been installed, it is advisable to start it and then, while the motor is running, blow some smoke toward it and note how the smoke is drawn through the motor by its ventilator.

The motor should be so aligned on its foundations that driving and driven shafts are parallel. Pulleys must be in line, otherwise the belt will not run true. Misalignment of the motor shaft with the driven shaft will set up a cross strain on the bearings which will produce undue wear.

Where the motor is geared to the driven unit, the machines must be

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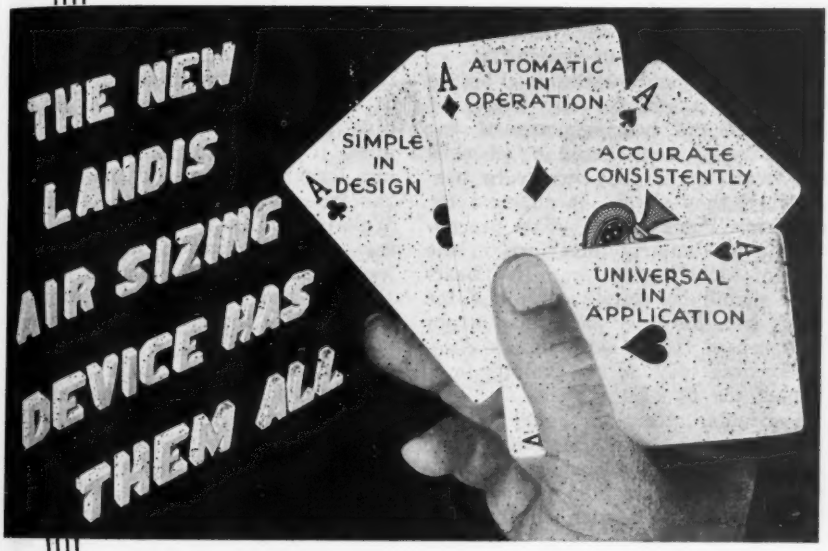
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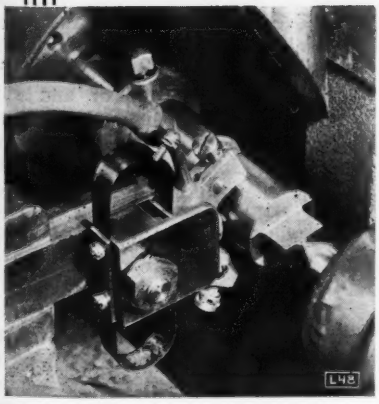

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accurately aligned and rigidly anchored; an error of a few thousandths of an inch in alignment may produce vibrations that might ultimately break the shaft or wreck the gears. When gears are meshing properly, it should be possible to pull a thin piece of paper through between the mating teeth without tearing it.

Bearings should be examined before the motor is run for any length of time. If the bearings are of the sleeve type, they should be checked for wear and if they are worn perceptibly, they should be changed for new ones immediately. This precaution is particularly important in the case of induction motors. Ball bearings should be closely examined for wear, but the inner races should not be removed from shafts unless absolutely necessary as removal tends to impair the fit of the race.

Particular attention should be paid to the matter of lubrication. Some greases have a tendency to separate and oxidize during idle periods, and the grease may harden on the balls and in the races so that the balls may be prevented from functioning. As most ball or roller bearings will allow the shaft of a motor to be revolved by hand, the need for unusual effort in turning the shaft will indicate that the bearings are full of gummy oil. This condition may be remedied by flushing out the bearings with gasoline, kerosene, benzine or carbon tetrachloride. After flushing, pour in some warm lubricating oil and try rotating the shaft again. If the bearings are in good condition, repack with grease that has the stamp of approval of the bearing manufacturers, filling the bearing about one-fourth to one-third full. It should be remembered that exposed ball bearings must be protected against the admission of dirt, and the housings should be inspected to make sure that the original seals used to prevent the entrance of dirt and other foreign matter are in good condition.

With the bearings properly cleaned and oiled, steps should be taken to assure proper lubrication henceforth. Oil wells should be filled with a petroleum oil commonly known as high grade dynamo oil. Animal or vegetable oils or admixtures of the two of them with petroleum oils will not give good results. Such oils will gum, if the motor is left standing any length of time, and thus prevent the free flow of oil to the bearings. Wells should be filled to within 1/16 in. of the top of the overflow gauge, and the oiling should be done through the oil filler or overflow gauge while the motor is at a standstill.

New motors are usually shipped with sufficient grease in the bearings to last for a limited period. The bearing housings should be almost half full of a good quality of neutral bearing grease. Old grease should be removed and new grease applied at least once a year. In oiling a motor, however, care should be taken to avoid over-oiling; an excess supply of oil is as bad as none, for the reason that excess oil will run down onto the coils and soak into the insulation in which case any dirt or dust that is drawn into the motor and which would ordinarily pass through will be caught and retained by the oil. In a short time the dust and dirt will fill up the spaces between the oil-soaked coils and the air circulation will be shut off. Overheating and destruction of the armature may result.

The air-gap should be checked to make sure that it is even all the way round. If the rotor is striking the iron of the field, no further evidence is needed that the bearings are worn and should be replaced. A rumbling sound at the start of the motor in-

dicates a worn bearing, even though the rotor does not quite touch the stator.

The stator should be tested for "shorts" and examined carefully to make sure that the windings are in good condition. Some motor experts suggest the use of the megger test as a simple and fairly accurate indication of the condition of the insulation between the windings and the ground. Should the megger readings show zero, a breakdown is evident and the windings should be overhauled. If the motor shows any reading less than 500,000 ohms, the stator should be given a general cleaning and drying. It should be thoroughly cleaned and then tested with the megger. If the readings are not satisfactory, there is a good chance that dampness is still present and the stator will require further drying.

If the ventilation is good, so that there is no danger from explosion or fire, gasolene or benzine can be used to clean the windings, otherwise carbon tetrachloride should be used. When the stator is thoroughly dry, a good coat of insulating varnish should be brushed or sprayed on.

A rotor that has been cleaned can best be dried by placing in a baking oven that can be set over a fire in the usual manner. If such an oven is not available, the motor can be mounted on an insulated base and connected by belt to the line-shaft so that it can be run idle. Shunt fields will normally dry out if run in this manner, and the other windings will be helped considerably.

Commutators should be clean and smooth, and the mica segments not only should not project above the copper, but should be under-cut below the surface of the commutator. This can be done by slotting between the copper segments with a saw that is just a few thousandths of an inch wider than the mica. The mica should be milled down to perhaps 1/64 in. below the surface of the commutator.

If the commutator is rough and worn from long service, it should be machined off by putting the armature into a lathe and taking a cut across the surface of the commutator. This, of course, should be done before the mica is undercut. Just enough copper should be removed to give the commutator a smooth surface. Although copper is a soft metal, the commutator should not be run at a high rate of speed on this operation; rather it should be comparatively slow.

The tool should be ground almost to a diamond point and stoned to a fine edge, and a fine feed should be used. With such a tool a good, clean cut can be taken without dragging the copper across the mica from one copper segment to another, which would cause a "short." After the turning cut has been taken, the armature should be revolved at a high rate of speed while the operator polishes the armature with a piece of fine sand paper attached to the flat side of a block of wood. And sandpaper is correct; emery paper or cloth should never be used on a commutator; it will scratch the copper and ruin an otherwise good job.

Brushes should swing freely in their holders and at the same time make firm, even contact with the commutator. If they stick in the holders, it is usually due to an accumulation of dirt and oil. Brushes should all be of the same length, and should be smooth and even at the contact end, with the contact end ground out to the same arc as the commutator so that perfect contact will be made. This fit can be obtained by winding a piece of sandpaper around the commutator and revolving the commutator slowly

with the brush in contact.

The position of the brushes should not be changed unless it is known that their positions are incorrect. Neither should the direction of rotation be changed. On motors with commutating poles, the brushes are fixed on the neutral point at the factory. This position should not be changed except to make changes or for compounding or parallel operation.

Pigtails or flexible copper conductors should be firmly fastened in place in order to carry the full amount of current from the brush to the holder. A slight extra length should be left, as, if they are too tight, the brushes will be pulled out of line and out of proper contact with the surface of the commutator.

Excessive heating of motors can usually be traced to one of three principal sources; in the armature, due to heavy overloads, to excessive room temperatures, to short circuits or grounds, to dirt obstructing the air passages, or to worn bearings; in the field coils, due to short circuits, grounds, or excessive voltage; or in the commutator, due to sparking or excessive brush tension.

When a motor fails to start upon application of current, the cause can generally be traced to one of four faults: (1) cut-out contact dirty, or phase circuit not closed; (2) open phase winding; (3) open main winding, or (4) tight bearings. A systematic inspection at least once a week is a good habit to get into. Cleanliness is of great importance to the life of a motor; freedom from water, oil, dirt, grease, or other foreign materials, inside and out, is good insurance against premature failure.

Diffraction Patterns

(*Continued from page 10*)

ent metal is represented in Fig. 9. It shows an unusual amount of strain in the metal as it came from the mill, but it so happened that the chemical analysis was in error, bringing about an unusual condition in the crystalline structure for this work.

The diffraction pattern of the deposited metal is shown in Fig. 10, showing the severe stains set up in the cooling of the weld and the necessity for relieving these stresses.

Figure 11 shows the pattern of the parent metal adjacent to the weld. The effect of the strains from the weld can be seen, but this pattern also shows the refining influence of the heat from the weld. The area from which this pattern was taken was also examined under the microscope, which revealed a considerable amount of grain growth right back of the immediate area.

Figure 12 is a pattern of the deposited metal after the stresses had been relieved by annealing at a low heat. The absence of strain and crystal distortion is evident.

"Causes of Skin Sores and Boils Among Metal Workers"

A booklet comprising an investigation by the Houghton Research Staff, published under the title quoted above, has been released by E. F. Houghton & Co., Third and Sometset St., Philadelphia, Pa. Recognizing the importance of a problem which exists wherever liquids of oil or soap content are used as aids in metal cutting or working; i.e., the prevalence of boils and sores among the workers, the Houghton Research Staff made a minute and exhaustive investigation of the conditions surrounding the uses of oils in the machine shop. The results of that investigation have been summarized in plain, non-scientific language that can easily be understood by the practical man, and published in the form of a 52-page book. This book will be sent free to any plant executive upon request.

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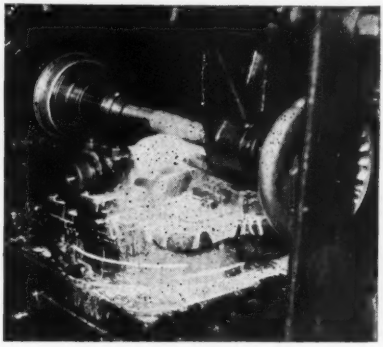

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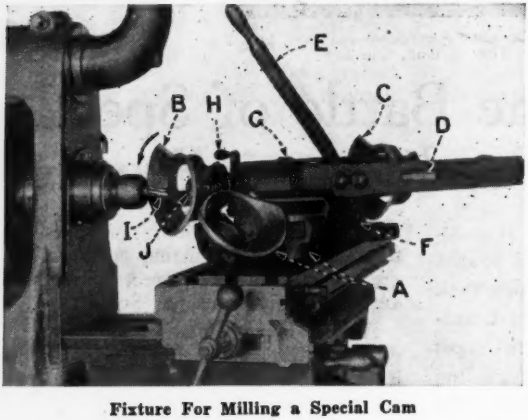
IDEAS FROM READERS

Milling Special Cams

By Avery E. Granville

IN THE building of one of our special pieces of equipment we use a cam which must be interchangeable with those made for other machines of this type. While quite a number of these cams are used in a season, still not enough are required so that it would be economical to buy a special cam-making machine for this job. For this reason we made a special fixture, shown in the illustration, to be used on a regular plain type milling machine.



Fixture For Milling a Special Cam

The fixture is so designed that it can easily be attached or removed from the milling machine table in a few minutes. The only other special equipment required, besides the fixture, is a small steel-nose cap which screws onto the spindle of the machine to hold the cutter, as shown.

In the illustration two of the special cams can be seen at A and one is in position in the fixture at B. A split compression collar is a part of the cam, and this collar is used to hold the cam onto the work spindle of the fixture. At the opposite end of the work spindle is a master cam, C, which is keyed in place. The contact surface of this master cam is kept in contact with a hardened steel stop, or guide, indicated at D. The work spindle is moved toward or from the milling cutter by means of the hand lever E, which operates a fork and collar pivoted at F. The necessary rotary movement is obtained through the worm gear G on the work spindle, the spindle being splined and a fixed key being used in the worm gear. Motion is imparted to the worm gear through a worm that is mounted on the hand crank H.

As will be noted, the stop for the master cam is in direct line with the milling cutter. In setting up, it is necessary that the cam to be milled be placed in the same relative position on the work spindle as the master cam, otherwise the milling would not be accurate.

In the illustration it appears at first glance that the cutter is in contact with the inside bevel of the cam, but this is not the case. The fixture, carrying the work, has been withdrawn from the cutter in order that the work may be seen more clearly.

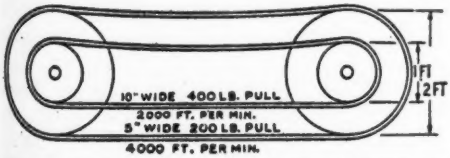
In use, the machine table is run in until the cutter contacts the periphery of the cam at the point indicated at J, nearest the observer, and exactly in line with the center of the work spindle and milling machine spindle. The milling cutter revolves in the usual direction and the cam is revolved as indicated by the arrow.

Using More Belting Saves on Maintenance Costs

By W. F. Schaphorst

THERE are many ways in which the life of belting can be prolonged and the maintenance costs reduced. One way is to reduce the pull on the belts, which incidentally reduces the power required and thus provides an additional saving. The amount of pull required to turn a shaft depends very largely upon the diameter of the pulleys; the larger the pulleys, the less the amount of pull or power required.

The drawing illustrates the fact that if a pulley 12 in. in diameter is to be operated at a speed of 2,000 feet per min., a 10-in. belt will be required. The belt pull on the bearings will be 400 pounds. Now in place of the small pulley let us substitute one twice as large, or 24 inches in diameter. In this case a 5-in. belt will do the same work and do it better, due to the fact that more pulley surface is presented to the belt. The belt speed will be 4,000 feet per min., which is not excessive, and the belt pull on the bearings will be reduced to 200 pounds. The reduced tension on the belt will add very considerably to the life of the belt—much more than enough to offset the cost of the extra length required—and the amount of power required to turn the shaft will be cut nearly in half.

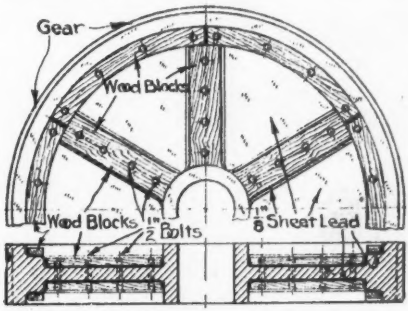


Drawing showing how a larger pulley and longer belt will reduce power required and save the belt.

Silencing Noisy Gears

By Morris A. Hall

SOMETIMES the racket and clatter set up by a big noisy gear is such that work requiring any amount of concentration is impossible in the vicinity. In the majority of cases, the gear can be silenced by applying lead sheets to the gear as shown in the illustration. The lead sheets are held in place by means of wood blocks cut to fit the contour of the gear, the blocks being held by bolts the holes for which must be drilled through both the wood and the arms and rim of the gear.



Lead and wood pieces, applied to a noisy gear, will effectively absorb vibration and noise.

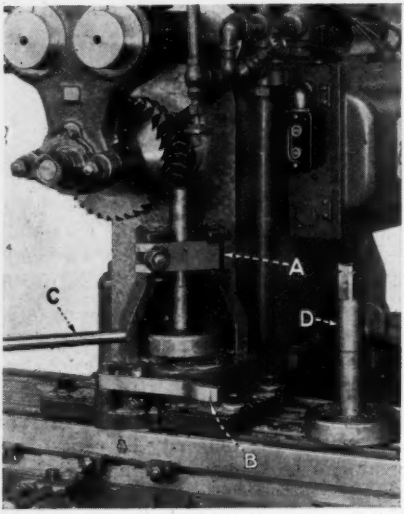
Not only large gears, but other noisy units such as sprockets can be quieted in the same manner. The materials consist of ⅛-in. sheet lead, ordinary boards, and ½-in. bolts. In the case illus-

trated, segment-shaped pieces of lead and wood were fitted between the spokes and continuous strips were bolted to the sides of the rim. The lead absorbs all vibration and noise.

Fixture for Squaring Ends of Shafts

By John McCullagh

HAVING some gear shafts that had to be finished square for a short distance at the ends, we arranged to do the job in a horizontal milling machine, using the fixture shown in the illustration.



Index Fixture for Squaring Ends of Shafts

This fixture is of the indexing type, having a single handle that provides both the index and the lock for the rotating part of the fixture.

As the specifications called for square shoulders, the possibility of feeding the cutters in from the end of the work was eliminated as this method would have resulted in a radius on the shoulder equal to that of the cutter. Instead, the fixture was made so that the work could be loaded vertically, the piece being located from the outside face of the gear blank on three fixed hardened buttons. Alignment is obtained by the use of a V-block into which fits the turned part of the shaft, just below the part that is to be milled. The piece is clamped by means of the hinged-type clamp A, which is tightened in place by an eyebolt.

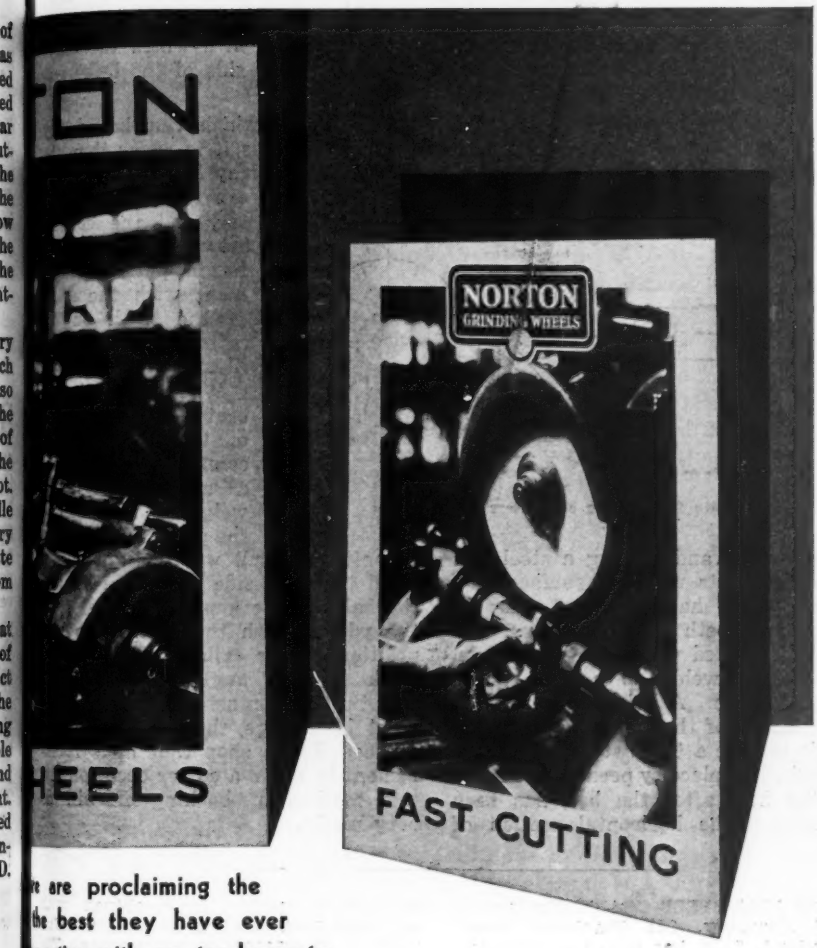
To index the fixture, it is necessary to pull the handle B outward, which withdraws the index plunger and also releases an angular locking plate. The fixture is then indexed by means of the pin C, being revolved until the plunger enters the second index slot. As the piece revolves, the handle moves inward, locking the rotary member by means of the locking plate so that the fixture will be free from vibration during the cut.

The fixture is built somewhat heavier than is usual for a piece of work of this size, in view of the fact that the height of the cut above the table. The design of the clamping and indexing mechanism is so simple that the piece can be indexed and locked with a single, quick movement. Two half-side milling cutters are used for the operation, as shown. A finished piece of work is indicated at D.

Backing-Off Device for Toolroom Lathe

By Harold F. Karrenbauer

THE accompanying drawing shows the design of a backing-off arrangement for the toolroom lathe which has proved its worth in our shop. The shop being of the maintenance type, we have no backing-off machine and have been buying our milling cutters from outside concerns. Recently, however, we had occasion to



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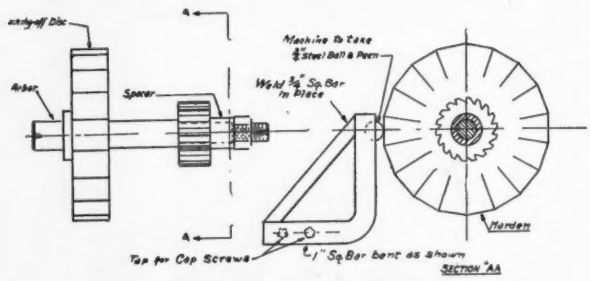
Grinding Wheels; Abrasives for Polishing; Abrasive Bricks and Sticks; Pulp-d Aggregates—Behr-Manning Abrasive Paper and Cloth—Norton Pike Oilstones

use a number of formed milling cutters, which we made in our own shop and backed off with the device shown. The device worked perfectly and with excellent results.

The device consists primarily of a section of 1-in. square steel, bent at right angles and holding a steel ball which contacts with the surface of a wheel which has as many sides as there are teeth in the cutter. The angle is braced with a piece of ¾-in. bar which is welded to the 1-in. square bar as shown. A hole is machined in the surface of the vertical side of the angle to take a ¾-in. steel ball, which is locked in place by peening the edges of the hole after the ball has been inserted. The horizontal section of the angle is drilled and tapped for two capscrews, with which the angle is bolted to the side of the lathe carriage.



Device for backing off cutters in the lathe

The wheel, which can be of any width as long as it is wider than the cutter, has as many flat sides as there are teeth in the cutter, and the corners between the flats must be in perfect alignment with the faces of the teeth on the cutter as shown in the illustration.

When ready to operate, the cross feed of the lathe is disconnected and either a spring or heavy weight is attached to the cross slide so that a continuous pull will be exerted toward the rear side of the lathe and the ball will be kept in contact with the wheel. With the cutting tool in position at the tailstock side of the work and the angle in position so that the ball contacts the wheel at the right hand edge, the job is ready to proceed. For a shop that finds it expedient to make a cutter occasionally, this method of backing-off will do very nicely.

END MILL SPEED CHART. The Weldon Tool Company, 321 Frankfort Street, Cleveland, Ohio, has issued a wall chart which is of general interest to shop executives. The chart lists the proper cutting speeds for machining tool steel, machine steel, and cast iron with end mills from 1/16 inch up to 2 inches in diameter. A chart can be had by writing the Weldon Tool Co.

P & W "ELECTROLIMIT" GAGE. The Pratt & Whitney Company, Hartford, Conn., has issued a booklet describing and illustrating the P & W "Electrolimit" Gage. In this new instrument, mechanical gaging is combined with electrical magnification to obtain either internal or external measurements. The gage can be set to any limits desired, and as fine as millionths of an inch. The book contains a number of pictures of the gage in use, and describes the operations shown. Copies free.

Advertisers like to know whether or not their advertisements are being read. When inquiring about machines, tools, or equipment advertised in this magazine, please mention MODERN MACHINE SHOP. Your cooperation will help to build up a bigger and better magazine for your own benefit.

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whether it be

CARBOLOY CEMENTED

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or a combination of one or more of these or other carbides

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When you purchase cemented carbide from Carboloy Company, Inc., you *automatically* receive the kind of cemented carbide which past experience has shown to be best for your particular applications, whether it be tungsten carbide, tantalum carbide, titanium carbide or *any other type* of cemented carbide made.

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On your next purchase of cemented carbide, take advantage of Carboloy Service—a unified service covering all types of cemented carbides made.

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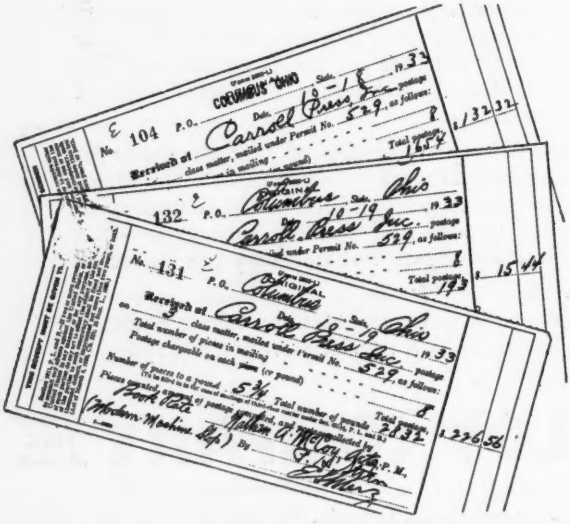
Over the Editor's Desk

The Trend

ACCORDING to information received from machine tool builders concerning the orders now coming in for machine tools, the advent of a general business recovery is definitely indicated. The curve on the chart of machine tool business rose sharply in the third quarter of this year, and appears to be continuing.

The market for machinery and tools has now been dormant for approximately two years, and the need for machines and parts, both for replacements and repairs, is obvious. Aside from the need for machinery and equipment for maintenance purposes, however, new developments and improvements during the last few years have put many types of machines and tools on the obsolete shelf. With all industry restricted to a given maximum of working hours and a minimum wage rate, it becomes imperative to produce at the lowest cost possible. And low costs are not possible with antiquated equipment.

We suggest that readers watch carefully that section of this magazine in which new tools and machines are announced. A small army of high-grade, experienced machine and tool designers—the best of their profession in the world—are bending constantly to their task of developing better methods and more accurate machines for American industry, and it is not uncommon to discover that a machine has been brought out which will more than pay for itself in a short time, either through reduced costs or by improving the quality and thus the saleability of the product.



5¾ pieces per lbs., 1654 lbs. Total pieces.... 9,510

5¾ pieces per lb., 193 lbs. Total pieces.... 1,109

5¾ pieces per lb., 2832 lbs. Total pieces....16,284

Copies mailed to foreign countries, stamps affixed 109
Copies mailed in U.S.A., stamps affixed 117

Total 27,129

PURSUANT to statements made on page 43 of the September issue of MODERN MACHINE SHOP, the United States Post Office receipts showing the number of copies of the October issue of this magazine that were placed in the mails are reproduced above.

Cut Your Tool & Die Costs

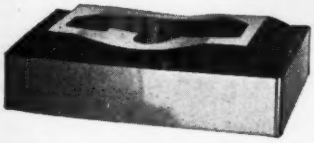
with the

New Baker Contour Grinders

Extreme rapidity for grinding and polishing dies, cams, and irregular shapes enables the New Baker Contour Grinders to provide users with savings that pay for the tool in a very short time.

Every tool and die shop . . every tool room doing hand grinding or polishing has a need for a Baker Contour Grinder.

Illustrated below is a typical finished job . . It's ground . . no hand polishing necessary.



Complete details given in new bulletin. Write for copy today.

No. 3 Contour Grinder . . Also built in No. 2 size.

BAKER BROS., Inc.
Toledo, Ohio, U.S.A.

NEW SHOP EQUIPMENT

Milwaukee Rail-Type Milling Machine

Kearney & Trecker Corporation, Milwaukee, Wisconsin, announces the addition of a rail-type milling machine to its present line of machine tools. Many noteworthy features have been incorporated, among which are unusual rigidity throughout the entire construction, a drive to the spindles that reduces gear contacts to a minimum in order to overcome backlash, smoothness in operation to overcome vibration and chatter, versatility and ease of control.

Milwaukee Rail-Type Milling Machine

The machine has been developed to use tungsten carbide cutters so that the utmost with this alloy can be obtained. However, the machine can be furnished with optional speed ranges basically suited for other forms of cutting metals.

The machine embodies the unit principle of construction and includes major assemblies consisting of a bed and table, two upright housings, a rail and a tie-plate which connects the upper ends of the two housings. This method of construction enables the machine to be made in three different widths, and with various lengths of feeds, as may be required.

Starting with the No. 2200 series as the smallest size, which constitutes a machine having a table 22 in. in width, the size of the machine is increased to the No. 4200 series having a table 42 in. wide. The intermediate series has a table 30 in. in width. All three series machines can be furnished with either 7, 9 or 11 ft. of longitudinal table travel.

Regularly four spindles are furnished, two of which are of the vertical type mounted on the cross rail, and two of the horizontal type, one each mounted on the two side housings. However, two horizontal and one vertical spindle, or two vertical and one horizontal spindle, or other combinations, may be selected to suit specific requirements.

All spindles can be furnished either fixed or to swivel. If two vertical spindles of the swivel type are furnished, they may be swiveled 45 degrees toward each other, or 25 degrees away from each other. Each spindle is mounted in a 7-in. diameter quill and is provided with a quill adjustment of 7 in. All spindles are made of alloy steel, heat-treated, hardened and ground, mounted on heavy-duty roller bearings, and are furnished with a standardized spindle nose.

Separate spindle speed change gears, giving 10 changes of speed, and separate reverse gears, are furnished for each spindle, so that the speed and direction of rotation of each spindle is independent of any other spindle.

Any one of three spindle ranges can be furnished: 20 to 135 r.p.m., for use when cutting steel or cast iron with

high-speed steel cutters; 50 to 350 r.p.m., recommended for milling cylinder blocks, crankcases, and other cast-iron work of a similar nature, using tungsten carbide cutters; and 75 to 500 r.p.m., for use when tungsten carbide cutters are to be used for milling aluminum.

The drive from the pinion shaft to the spindle is through helical gears. The spindle gear of each spindle is solidly mounted on the spindle, whereas the driving pinion is splined. A heavy flywheel is carried on the spindle driving pinion shaft. These two factors, together with the heavy spindle, insure a smooth, steady spindle drive.

The machine is electrically operated. Four motors are used, all of which are controlled from a central panel located at the operating position at the side of the bed. For the No. 2200 series machines a 20-h.p. motor of the flange type furnishes power for all spindles. A 5-h.p. flange-type motor furnishes power for the table feed and table power rapid traverse.

A third motor is mounted on the tie rail at the top of the machine and furnishes power for raising or lowering the cross rail. The fourth motor is furnished to operate a centrifugal pump when coolant is required.

The table can be furnished with either one of two feed ranges, each of which has 18 changes: 1 to 40 in. per minute which is recommended when speed ranges of either 50 to 350 or 75 to 500 r.p.m. are used; and ½ to 20 in. per minute which is recommended to be used when spindle speeds of 20 to 135 r.p.m. are specified.

All adjustments for the side and vertical heads are by hand. All controls are convenient to the operator's position. The net weights of the machine, when equipped with four heads, vary from 28,000 to 42,000 lbs.

Monarch Precision Tool-Room Surface Grinder

The Monarch Machine Tool Company, Sidney, Ohio, has announced the development of a hand feed precision tool-room surface grinding machine. The features of this new Monarch Grinder are as follows:

The motor driven spindle is a compact one-piece unit. The entire unit is perfectly balanced, the rotor of the motor being pressed on the spindle shaft. The spindle is mounted in Ex-Cell-O Precision ball bearings with a minimum of radial and end play. Spindle bearings are perfectly protected against abrasives and foreign substances. This construction eliminates the use of belts, pulleys and idlers with their attendant evils.

Automatic force feed lubrication, which Monarch has so successfully applied to lathes, is used for the perfect lubrication of the entire grinder—except

Monarch Precision Toolroom Surface Grinder

the spindle bearings, which require special oil.

The oil reservoir is in the grinder base, easily filled from the outside. The high pressure oil pump supplies oil automatically through metering pins to all bearing surfaces and all parts requiring lubrication. The pump is operated from a cam on the cross traverse hand wheel. This type of lubrication has many advantages, such as:

1. Minimizes wear of all sliding surfaces and all operating parts, preserving accuracy.

2. Insures proper lubrication at all times.
3. Saves operator's time.
4. Promotes smooth easy hand operation.

Special care was used in the designing of the Monarch Grinder to perfectly protect all sliding surfaces from abrasives. A system of flat steel pieces protects the spindle carrier and column bearings, and the space between the base and the saddle. The saddle "V" ways and the table ways are protected by closely fitting drawn steel angle pieces.

All castings, except the cabinet base, are normalized to remove casting strains and prevent the possibility of distortion and warpage. This insures that table saddle and column bearing surfaces will remain true and that extreme accuracy will be preserved. A three-point bearing between the cabinet base and grinder base eliminates strain.

The construction of the spindle carrier and column bearings is such as to hold the spindle rigidly at right angles to the table and prevent movement or chatter. Should the spindle carrier ever need refitting in its column bearings, this can readily be done, as the columns are separate units.

Instead of the usual rack and pinion for table traverse, with its tendency to produce gear tooth marks and accumulate back lash with wear, a roller chain and sprocket is used. This chain is operated by a sprocket mounted on a splined shaft, which is geared to the traverse hand wheel shaft. One turn of the 7" diameter traverse hand wheel gives 2" table travel.

The chain is pinned to one end of the table. A convenient adjustment is provided at the other end, eliminating all lost motion. Absolute smoothness to the table travel is always given, resulting in perfect surface grinding.

Both traverse and cross feed hand wheel shafts are mounted in anti-friction bearings, eliminating wear and contributing to the smoothness and ease of operation. An adjustable nut on the spindle elevating screw provides adjustment for wear and eliminates back-lash.

Specifications

The length of table travel is 18"; cross saddle travel, 6¾"; dimensions of table, 46" long—8" wide; working surface of table, 18" long—6" wide; standard wheel size, 7"x½"x1¼" hole. Vertical movement of wheel spindle, 9"; maximum distance from standard wheel to table, 9"; maximum distance from standard wheel to magnetic chuck, 6". Graduations on wheel spindle, one-half-thousandths.

Motor in-built, 1 h.p. 3500 r.p.m. full load, furnished in either 50 or 60 cycles, 220, 440 or 550 volt. Equipment furnished includes one 7" dia. ½" thick, grinding wheel; diamond tool holder bracket and wrenches. Overall floor space occupied—66" wide x 41" deep x 72" high. Net weight, 1400 lbs. Crated weight, 1700 lbs. Boxed weight, 1900 lbs.

The Ex-Cell-O high speed ball bearing spindle attachment, which fits over the front part of the spindle housing can be furnished. A pulley replaces the regular wheel and guard. The pulley is mounted on the regular grinder spindle and drives the high speed spindle. The bracket for holding the high speed spindle clamps in any radial position on the main spindle. Speeds to 18,000 r.p.m. can be secured.

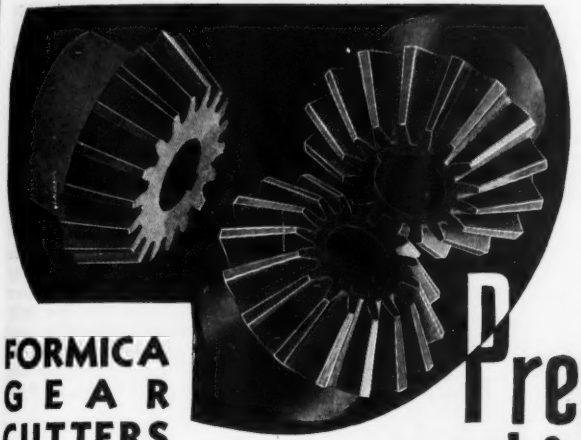
Fay 8-in. Automatic Lathe

A Fay Automatic Lathe in an 8-in. size, especially adapted for machining small parts or for light finishing operations on larger work has been brought out by The Jones & Lamson Machine Co., Springfield, Vt. The machine is light, flexible, and completely automatic in its cycle.

The tooling possibilities of the larger Fay lathes are incorporated in the design of this machine; multiple tooling can be arranged on the carriage to turn either straight or taper, and the back arm is arranged to face and form any number of shoulder lengths or diameters. A third cutting head can be installed for turning or facing, as required.

The headstock is equipped with a built-in motor, controlled by push-buttons conveniently located on a control panel on the front of the machine. The spindle, which is made from a steel forging and mounted on pre-loaded ball bearings, has a flanged nose 6¼ in. in diameter, with a taper pilot. All gears are mounted on splined shafts running on ball bearings. A solenoid brake is built into the headstock for stopping the machine. All gears and shafts run in a bath of oil and all running parts are lubricated by the splash system.

The machine is regularly furnished with three sets of speed change gears which provide six spindle speeds in each of four groups ranging from 104 to 1,610 r.p.m. Special gears for higher or lower speeds may be supplied if desired. Equipment includes three sets of feed



FORMICA GEAR CUTTERS

Prepare your machines with FORMICA PINIONS

The Akron Gear & Engineering Co., Akron, O.; Farrel-Birmingham Co., Inc., Buffalo, N. Y.; Slaysman & Company, Baltimore, Md.; Harry A. Moore, Bangor, Me.; The Union Gear & Machine Co., Boston, Mass.; The Atlantic Gear Works, Brooklyn, N. Y.; Chicago Rawhide Mfg. Co., Chicago, Ill.; Perfection Gear Company, Chicago, Ill.; Merkle-Korff Gear Co., Chicago, Ill.; Chicago Gear Company, Chicago, Ill.; The Cincinnati Gear Co., Cincinnati, O.; The Horsburgh & Scott Co., Cleveland, O.; The Stahl Gear & Machine Co., Cleveland, O.; The Master Electric Co., Dayton, O.; The Adams Company, Dubuque, Ia.; The Ferguson Gear Co., Gastonia, N. C.; Hartford Special Machinery Co., Hartford, Conn.; Precision Machine Co., Milwaukee, Wis.; Joaquin Alemany Lopez, Havana, Cuba; The Generating Gear Co., Milwaukee, Wis.; New Jersey Gear & Mfg. Co., Newark, N. J.; J. Morrison Gilmour, 151 Lafayette St., New York City; Sier-Bath, Inc., New York City, N. Y.; E. M. Smith Machine Shop, Peoria, Ill.; The Earle Gear & Machine Co., Philadelphia, Pa.; Rodney Davis and Sons, Philadelphia, Pa.; The Pittsburgh Machine & Supply Co., Pittsburgh, Pa.; Standard Gear Co., Pittsburgh, Pa.; The Turley Gear & Machine Co., St. Louis, Mo.; Perkins Machine & Gear Co., Springfield, Mass.; Winfield H. Smith, Inc., Springville, N. Y.; Alling Lander Co., Sodus, N. Y.; Charles E. Crofoot Gear Corp., South Easton, Mass.; Arlington Machine Co., St. Paul, Minn.; Farwell Mfg. Co., Toledo, O.; Diefendorf Gear Corp., Syracuse, N. Y.; Worcester Gear Works, Worcester, Mass.; The Massachusetts Gear & Tool Co., Woburn, Mass.

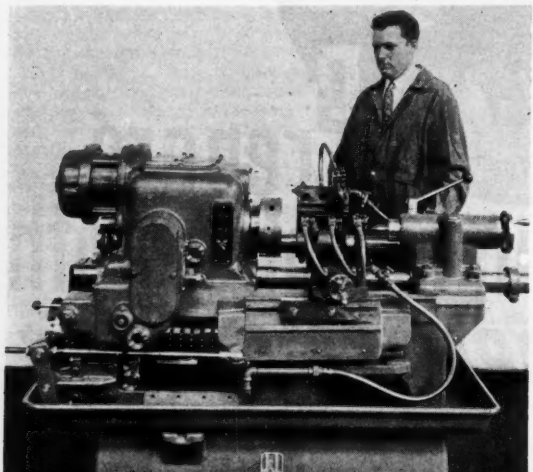
FASTER production is coming and when it comes you will probably have some work to do on your machines to get them in best operating condition. Formica gears and pinions will do that for you—and they will run quieter. They help to keep machinery operating smoothly and quietly. The gear cutters named on this page can give you prompt service on one or many gears.

THE FORMICA INSULATION CO.
4640 Spring Grove Avenue
Cincinnati, Ohio

FORMICA *Non-Metallic* **GEARS**

change pick-off gears, giving six different rates of carriage feed with the standard carriage cam ranging from 0.004 in. to 0.040 in. per revolution. Faster or slower feeds may be obtained by the use of special cams or special feed gears.

The carriage is supported on a hardened and ground adjustable former, and can be adjusted on the center bar to suit the requirements of the job. It has a cross slide that is controlled by a lead screw and graduated hand wheel. The former is mounted on a relieving slide, so arranged that at the end of the turning cut the tools can be relieved to avoid scoring the work on the return stroke. The return stroke is also automatic.



Fay 8-in. Automatic Lathe

The bed is of box-ribbed construction arranged so that the cam drum which controls all movements of the machine can be conveniently located under the headstock. A pressed steel pan provides ample chip room, and the base of the machine contains a large reservoir for coolant. The cams on the outside of the drum control all tool movements of the carriage, back arm control drum, located at the end of the machine, provides for convenient setting of the fast and slow motion dogs and the relieving cams for the front carriage or turning head.

The back arm is carried on an accurately-ground steel bar mounted in three bearings, and is operated by a hardened and ground former mounted on the rear former slide. An adjustable follower shoe provides for various diameters.

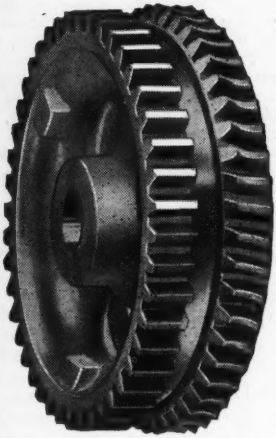
The machine is made in two lengths, 8x15 in. and 8x45 in. The swing over the carriage is 8 in. and over the center bar is 11 in. The hole through the spindle is 1⅝ in. and the spindle nose is 6¼ in. diameter. Floor space required for the 8x15 in. machine is 32x70 in. and for the 8x45 in. machine is 32x100 in. Net weights are, respectively, 2,850 and 3,600 pounds.

Kent-Owens No. 3 RV DS Miller Has Variable Speed and Double Spindler

A combination of double spindles with variable speed drive is the outstanding feature of a new milling machine developed by Kent-Owens Machine Company, Toledo, Ohio. The center distance between the spindles is adjustable over a wide range, which, with the variable spindle speed drive, fits this machine for handling a wide variety of operations. Further, proper adjustments in spindle speed and center distance to allow for cutter wear can quickly and easily be made.

Two standard ranges of spindle center distance are available, namely, 4¾ inches to 7⅝ inches and 5¾ inches to 9¼ inches. Other ranges can be provided for special requirements. The table working surface is 28 inches long by 7 inches wide with a wide chip and coolant trough clear around making the overall size 5 inches by 14 inches. It has two ⅝-inch T-slots and a ¾-inch plain center slot. The table can be fed 17½ inches either by power or with the star hand wheel. The cross saddle feed is 7 inches.

Any 3-to-1 spindle speed range can be



Good Gears are Necessary for Smooth Operation

If the product is to run smoothly over a long period of time, the gears must be good.

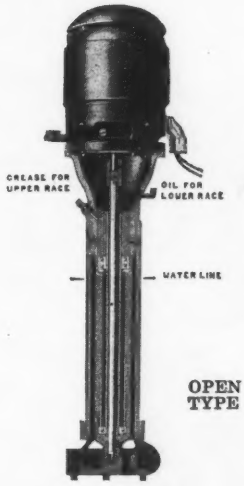
PERKINS Gears and Worms give users added accuracy, smoothness and dependability so necessary in successful machine performance. For smooth operation and absolute dependability, specify and order PERKINS Gears and Worms.

Without obligation we shall gladly quote you on your requirements. Send blue prints.

Perkins Machine & Gear Co.

151 Circuit Ave.
SPRINGFIELD, MASS.

BROWNIE COOLANT PUMP



FEATURES

Ball Bearings within one inch of impeller. Handles a heavy mixture of coolant impregnated with grit and chips as efficiently as clean oil or water.
Open and closed types.
Exceptionally large capacities 10-100 G.P.M.

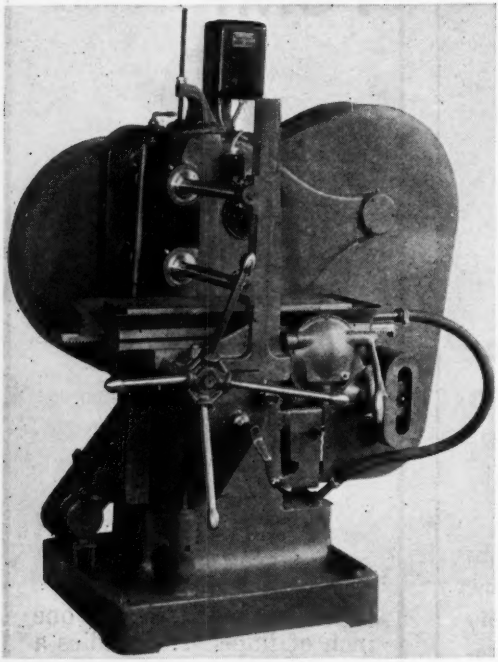
Mfg. by

Tomkins-Johnson Co.

620 N. Mechanic St.
Jackson, Michigan

had with a minimum of 40 r.p.m. and a maximum of 457 r.p.m. using an 1,160 r.p.m. motor; the standard speed range provided is 58 to 174 r.p.m. The spindles are No. 10 B. & S. taper with 17/32 inch clearance hole through and are mounted on Timken precision taper roller bearings both front and rear.

The drive is carried from the motor to the backshaft by a Vee-flat belt. This belt rides on a plain pulley on the backshaft and between two opposed cones on the motor shaft. Movement of the motor toward the backshaft causes the Vee-flat belt to ride near the outer diameter of the cones, thus increasing the spindle speed; lowering the motor forces the belt to ride on a smaller diameter of the cones which decreases the spindle speed.



Kent-Owens No. 3 RV-DS Miller

The motor is mounted on a vertical slideway and its movement up or down to effect speed changes is accomplished by a speed control handle conveniently located at the front of the machine. A spindle speed range of 3-to-1 is thus provided; this range is smooth and continuous and contains no steps or gearing. This is the same exclusive drive now used on Kent-Owens Nos. 1 RV, 2 RV and 3 RV Millers.

A 4-inch belt, on which rides a self-adjusting idler, carries the drive from the backshaft to the lower spindle. This idler keeps the belt tight at all times regardless of the power required at the cutter—or the vertical adjustment of the spindle, which slightly changes the center distance between the spindle and backshaft. The upper spindle is driven from the lower through two intermediate gears; these gears are adjustable to permit adjustment of the center distances between spindles.

A 5 h.p. 1,160 r.p.m. motor is recommended for average conditions. The net weight of the machine, without motor, is 3,100 pounds. The base is 28 inches in line with the spindles by 34 inches wide; the overall dimensions are 44 inches by 70 inches; the overall height is 70 inches.

"Delta" Bench Drill Press

A year ago the Delta Manufacturing Company of Milwaukee, Wisconsin introduced a new floor-type drill press which had many unusual features, and which has proved very popular in a wide variety of shops. The company has now introduced a bench model of the same machine which retains all the advantages of the larger model, but which sells at a lower price.

The overall dimensions of the new machine are: 36½" high; 10" wide, and 21" from front to rear with motor installed. The spindle is carried in a cast-iron head of massive design, and runs in self-sealed New Departure ball bearings. The spindle is of the free-floating type, in which all of the belt pull is taken by the 2" diameter ball bearing in the drive pulley, thus insuring free, sensitive operation, and preventing alignment troubles. The spindle is of precision-ground stock and has two keyways to prevent "edging" of the keys and to insure balance at high speeds.

The spindle is fitted with the patented

"MODERN MAGIC" CHUCKS GIVE SINGLE SPINDLE MACHINES MULTIPLE SPINDLE PERFORMANCE.

INSIST ON HAVING THE ORIGINAL and ONLY GENUINE "MODERN MAGIC"

All tool changes made with spindle revolving. No stopping necessary—drills, reamers, taps, counterbores and other tools accommodated. Several operations performed without removing work from machine.

Other "Modern" Products include stationary and revolving self-opening die heads, solid adjustable die heads, adjustable hollow milling tools, collapsible taps, friction tap collets, self-opening stud setters, tapping attachments, chaser grinders, inserted blade milling cutters.

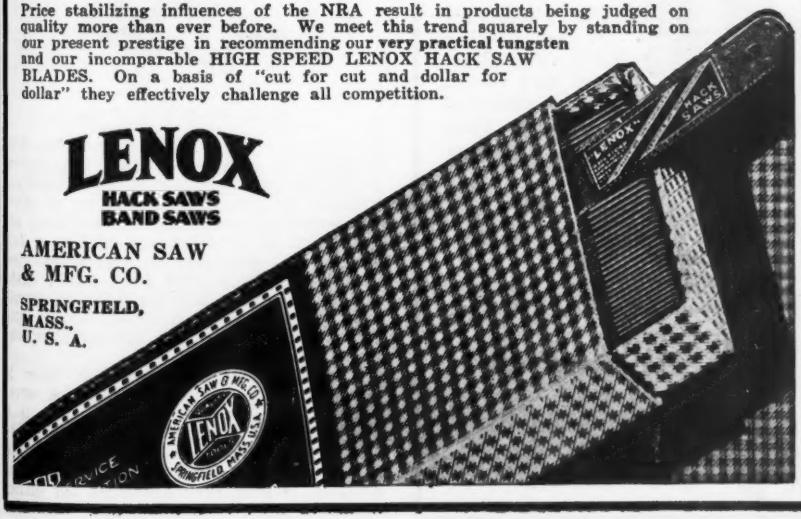
MODERN TOOL WORKS

ROCHESTER, N. Y., U. S. A.

DIVISION OF CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA.

Made "Extra Tough" to Stand Extra Wear!

Price stabilizing influences of the NRA result in products being judged on quality more than ever before. We meet this trend squarely by standing on our present prestige in recommending our very practical tungsten and our incomparable HIGH SPEED LENOX HACK SAW BLADES. On a basis of "cut for cut and dollar for dollar" they effectively challenge all competition.



No Thread Milling on Bath Taps

A Bath Tap is not merely "corrected" or "finished" after hardening.

The whole process of making Bath Taps eliminates any necessity for "correction." Bath Taps are first hardened at 2350° F. in the solid. Then they are "ground from the solid" giving you a finer, more accurate, longer lasting tap than by any other method.

Write today for the "Ground Thread Handbook"

John Bath & Co., Inc.

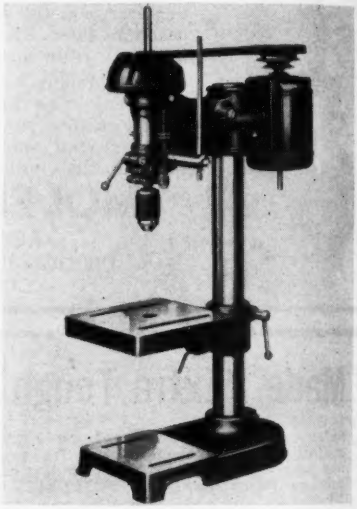
Taps — Chasers — Gages
WORCESTER, MASS.

Ground from the Solid

"Delta-Grip" chuck, of the self tightening type, having a capacity of 17/32" drills, and interchangeable spindles are available, one fitted with Jacobs chuck, one for No. 1 Morse taper-shank drills and one for standard ½" shank woodworking bits.

The quill is graduated and fitted with an adjustable pointer as an aid in depth drilling, and has stop rod and adjustable stop nuts for repetition depth drilling, mortising and routing.

In addition to its suitability for the machine shop, a number of pattern shops



Delta Bench Drill Press

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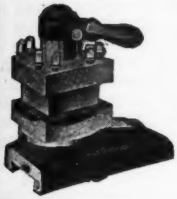

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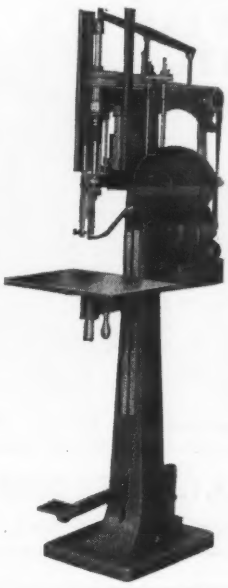

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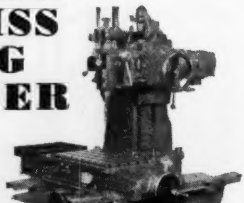

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Landis Air-Sizing Device

To meet the need for an efficient sizing device for use in connection with precision grinding operations, the Landis Tool Company, Waynesboro, Penna., has developed the air-sizing device shown in use in the illustration. The device is universal in application, inasmuch as it may be used for both external and internal grinding operations of all kinds. External or internal surfaces may be sized with equal facility, whether they be straight, tapered, radial, splined, keyweyed, or half diameters, and the device is ideal for raceway grinding.

The device is fully automatic, and

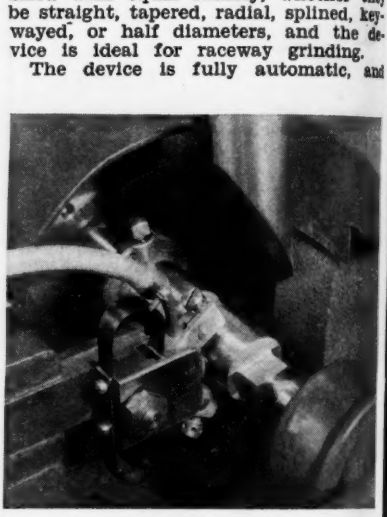

Fig. 1—Typical Landis External Grinding Sizing Head

may be made to control as many machine operations as are necessary. It is consistently accurate because it will size well within limits of 0.00025 in.

Operation of the device is based upon the principle that the escape of air from a pressure line affects the pressure in the line in direct ratio to the size and shape of the outlet. This change in pressure is utilized to control the level of the mercury in a U-tube so as to close contacts, and constitutes a mercury switch which controls feeds and other machine movements.

The illustration Fig. 1 shows a typical external grinding sizing head. The work, when placed between centers, rests lightly against two diamond points with the air outlet between the points. As grinding proceeds, the sizing head swings slightly upward, decreasing the size of

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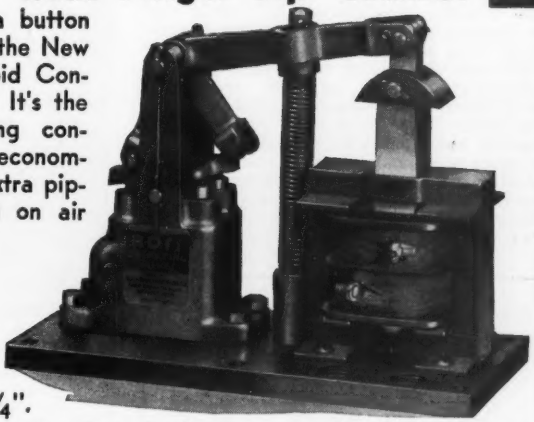

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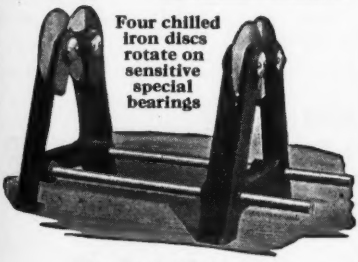

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the gap between the work and the outlet. Pressure slowly builds up in the air-line, causing the mercury to rise in the U-tube. Just before the finish size is reached, the mercury touches a contact, thus completing an electrical circuit and energizing a solenoid which retards the speed of the feeding-in movement. Grinding continues until the finish size is reached, the mercury having then risen in the tube until it touches a second contact, thereby completing a second electrical circuit, energizing a second solenoid and causing the wheel to back rapidly away from the work.

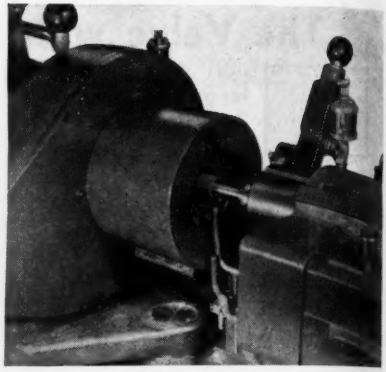
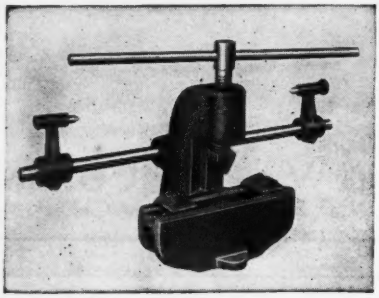


Fig. 2—Landis Air-Sizing Device Applied to an Internal Grinding Job

Figure 2 shows a typical internal grinding application. The tube that carries the air to the ground surface is plainly visible below the grinding wheel, but it never comes in contact with the work. With some applications, a second tube is used, as shown. As grinding proceeds, the inside diameter of the hole naturally increases and along with this, the size of the gap between the outlet and the work. Pressure in the line gradually decreases, the mercury in the U-tube functioning in a manner similar to the external device.

The device is quickly and easily set up, all necessary readjustments being provided for. Air pressure of from 2 to 20 lb. per in. sq. is used. Reducing valves provide for application to any air line, and an air filter insures clean air. The device is applicable only to Landis hydraulically operated grinding machines.



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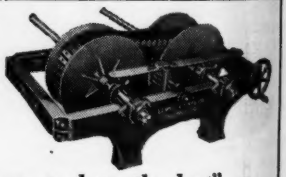

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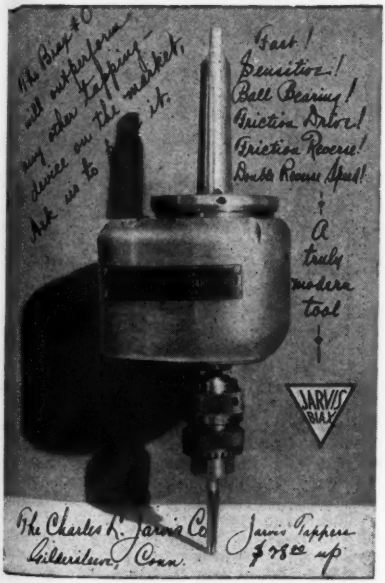

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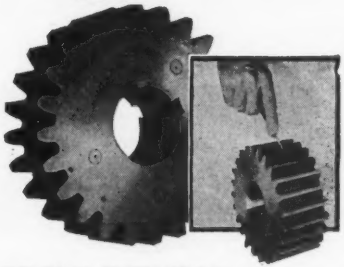

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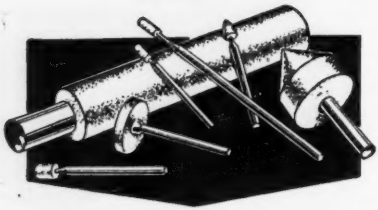

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Landis Typer V, L and H Hardened and Ground Die Heads

The Landis Machine Company, Waynesboro, Pa., has developed a new series of threading die heads designd to supplement, but not to supersede, their present line of heads. The new heads are built in the following types and sizes: ⅝ and ⅞ in. (Type V) "Lanco" heads for hand-operated threading machines; ⅝, ⅞, and 1¼ in. (Type L) "Landex" heads for automatic screw machines, and ⅝, ⅞, and 1¼ in. "Landmatic" (Type H) heads for turret lathes.

The heads are intended for use in high production or heavy duty service, or for work that must be held to extremely close thread limits. They are simple in design, rigid in construction, and are made from a special alloy steel, hardened and ground. Although the design of the heads is a radical departure from the conventional Landis design, the chasers used in the Type V, L, and H heads are the same as those used in the "Lanco", "Landex" and "Landmatic" heads now in use.

The chaser holders are mounted on the face of the head body, operating in dove-

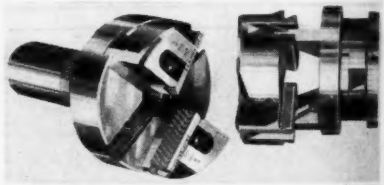

Fig. 1—Landis Hardened and Ground Die Head, dismantled to show the prongs of the closing ring by which the position of the chaser holders is controlled and the locking ring which controls the movement of the closing ring. The locking ring is shown in open position.

tail slots, and have an unusually wide bearing surface consisting of the combined areas of the base and the dovetail section of the chaser holders. The driving member of the die heads; that is, the shank or attaching flange, is attached directly to the head body. The drive is therefore direct, and no torsional strains are transmitted to the head adjusting or locking mechanisms or to the head opening or closing mechanisms.

The head opening action is obtained by moving the chaser holders away from the work. As shown in Fig. 1, the position of the chaser holders is controlled by the prongs which are an integral part

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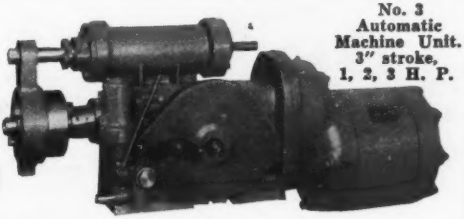

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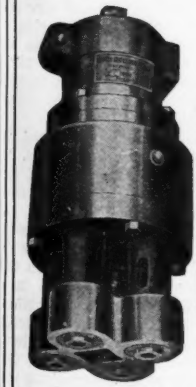

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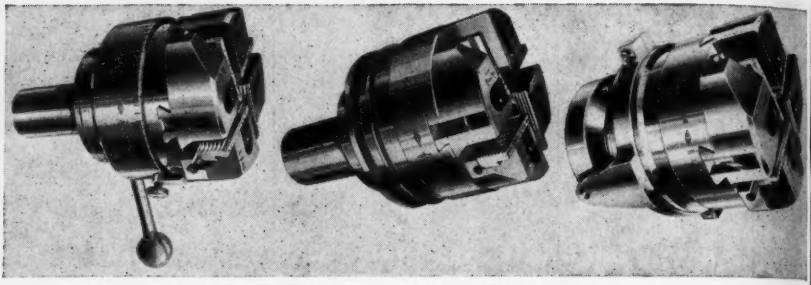

Fig. 2 (Left)—Type V "Lanco" Die Head for hand-operated threading machines. Fig. 3 (Center)—Type L "Landex" Head for automatic screw machine use. Fig. 4 (Right)—Type H "Landmatic" Head for use on turret lathes.

of the closing ring. The supporting surfaces of these prongs act as cams and, as a key in the chaser holder slot fits into a keyway in the prong, the action of the chaser holders, both to and from the "closed" or "locked" position, is positively controlled. The movement of the closing ring is actuated by spring pressure acting directly upon the closing ring itself.

The movement of the closing ring is controlled by a locking ring, which is shown in the open position in Fig. 1.

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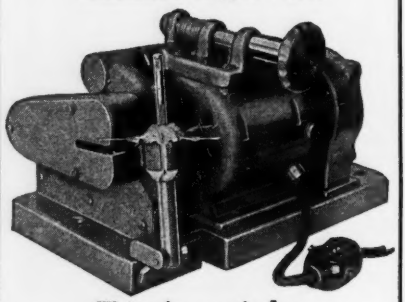

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To close the die head, the locking ring is rotated on the head body where, as the surfaces are tapered, it forces the closing ring forward. Four offset surfaces on the front of the locking ring hold the closing ring in locked position. The Type V and Type L heads are closed by means of a yoke; the Type H head may be opened and closed either automatically or by hand. The automatic opening action is obtained by interrupting the forward movement of the die head.

The mechanism for adjusting the dieheads to size consists of a threaded collar which screws onto the head body and which is in direct contact with the locking ring. The adjusting ring may be locked in position after the size adjustment has been made. The ring is graduated and each division gives an adjustment of 0.001 in. in the pitch diameter. Adjustments as fine as 0.00025 in. are possible because of the widely spaced graduations.

The chaser holders are designed to facilitate the changing of chasers, to permit of more accurate setting of the chasers with relation to the cutting center, and to afford a rigid support. A comparatively short chaser clamp, operated by a single hollow-head screw is employed for holding the chaser in the chaser holder. The clamp seats in a socket with a tapered bottom. When the clamp is drawn down, the clamping action is toward the base and the back of the chaser holder, thus seating the chaser firmly. A lip extending along the top of the chaser holder, and protruding slightly beyond the front of the clamp, properly supports the cutting edge of the chaser and prevents it from being thrown out of alignment.

The chaser seat is ground at an angle to the face of the diehead. When the

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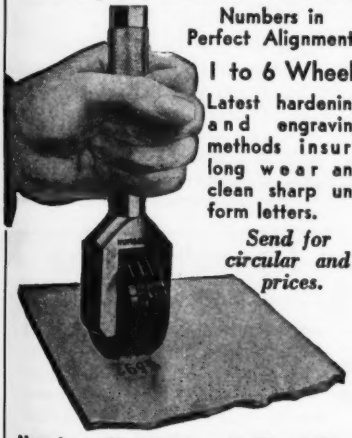

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chaser is clamped in the chaser holder, it is inclined at an angle to the work. This practice of controlling the helix angle in the chaser holder instead of in the chaser has the advantages of simplifying the setting and grinding of the chasers, permitting the chaser interchangeability, and making possible the use of chasers of a given pitch for threading any diameter of work within the range of the diehead. These dieheads can be employed for cutting both right- and left-hand threads by using the proper chaser holders. The same chasers are used for both right-and left-hand work by grinding the cutting angles at both ends of the chasers.

Bulletin No. F-80, now being distributed, gives complete details and specifications of the new dieheads.

Electric Carpenter

Metal manufacturing plants that make their own patterns will find a complete pattern shop in the "Electric Carpenter", which has been brought out by Electric Carpenter, Inc., Packard Bldg., Philadelphia, Pa. The Electric Carpenter is a combination of seven machines in one; a saw table, jointer, band saw, shaper, speed spindle, mortiser, and lathe, all powered through a single Master motor. Each tool can be operated independently, or two tools may be operated at the same time. Changing operations are simple; no machine parts are added or removed.

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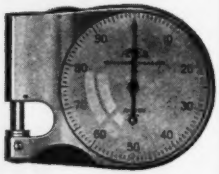

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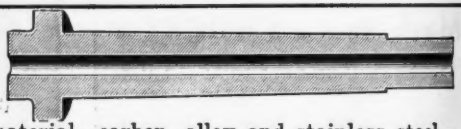

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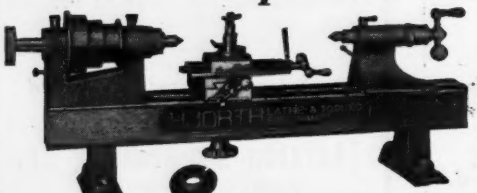

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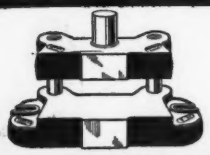

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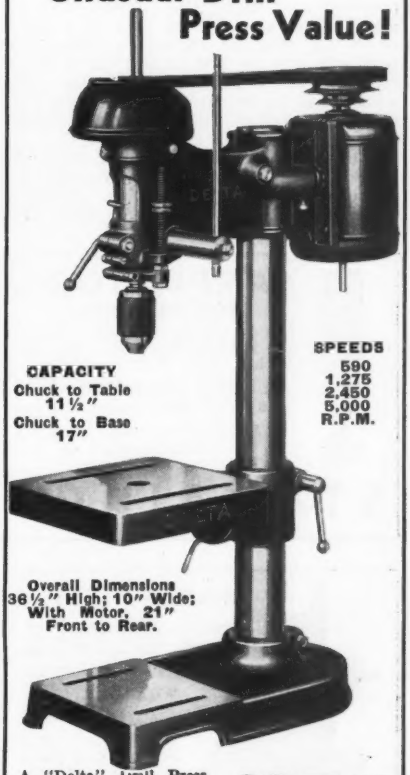

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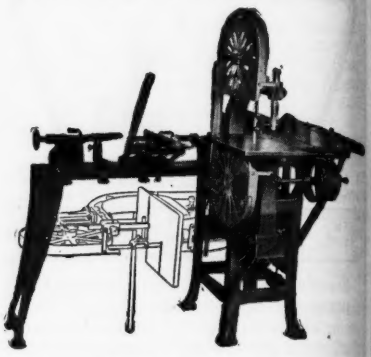
and can be run right or left hand. By lowering the band saw to a horizontal position and using the jointer, any desired width up to 6 in. and to a depth of ½ in. may be rabbeted. The band saw will cut to the center of a 28-in. circle. The table tilts to 45 deg. The wheels are 14 in. in diameter with 1-in. face and endless rubber tread. Aluminum safety guards insure safety.

The table can be adjusted vertically by means of a hand wheel. Provision is made for dadoes 6 to 7 in. diameter, 1 in. wide, with ⅝-in. spindle hole. The table is 21x33½ in. and the diameter of the saw in 8 in. Mortising is done with a hollow chisel of horizontal type, operated under powerful leverage, taking hollow chisels to ½ in. The table has vertical adjustment of 3 in. and the



"Electric Carpenter"

mortiser has a 4-in. stroke. The jointer is equipped with high speed steel knives 6 in. wide, and the jointer head operates on a separate spindle. The saw and jointer do not operate simultaneously.

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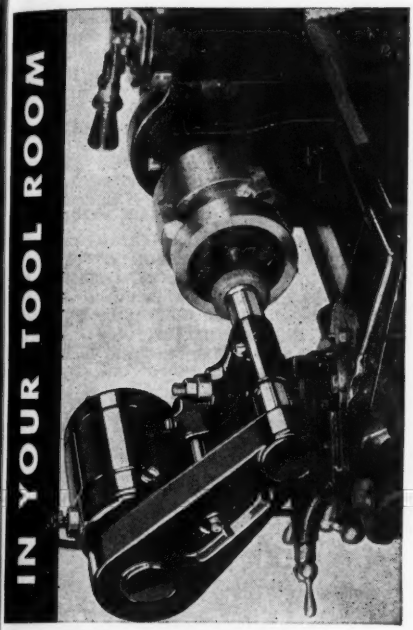

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slot in the saw table. For cross-cutting, the mortise table acts as a stop block, giving an accurate location of the cut to be made and eliminating the necessity of laying out dado and shelving work with a square and pencil.

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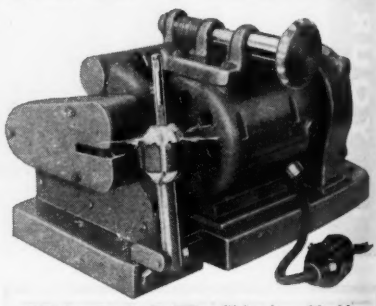

"Globe Junior" Wire-Skinning Machine

for skinning lead wires of armatures from 1 in. to 8 in. in diameter, and will clean the insulation from wire that has been covered with enamel, cotton with enamel, double cotton with enamel, silk with enamel, or rubber.

The machine is portable, and can be used anywhere by plugging the connection into a light socket. The machine requires bench space 7 x 12 in., and is 7 in. high. The weight is 30 pounds.

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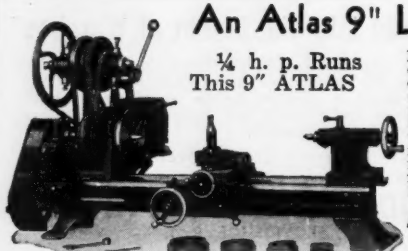

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wires are fed to the skinning mechanism through a slot in the front of the machine; thus the operator is fully protected from injury from the tool.

The motor operating switch is easily accessible in the front of the machine. The skinning mechanism consists of special wire brushes which operate at extremely high speed. The brushes are mounted on precision ball bearing spindles that are easily oiled and are driven by a ¼ h.p. motor, operating on 110 volts, 60 cycle, single phase current.

An exhaust system is incorporated in the machine, and all lint and dust are removed automatically through a flexible tube which can be connected with a water pan to avoid danger of fire. Adjustment for brush wear is provided at the top of the machine.

"Vertical Motors"

The above title is the subject of a new loose-leaf bulletin that has been issued by the Wagner Electric Corporation, 6448 Plymouth Ave., St. Louis, Mo. It illustrates and describes the three different types of vertical motors, and by means of many illustrations of applications explains how horizontal-type motors may be mounted vertically thus saving the cost of special vertical construction. Copies gratis.

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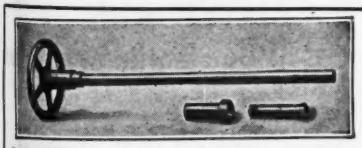

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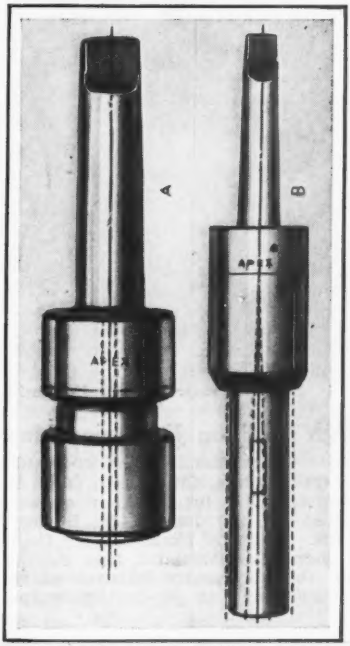

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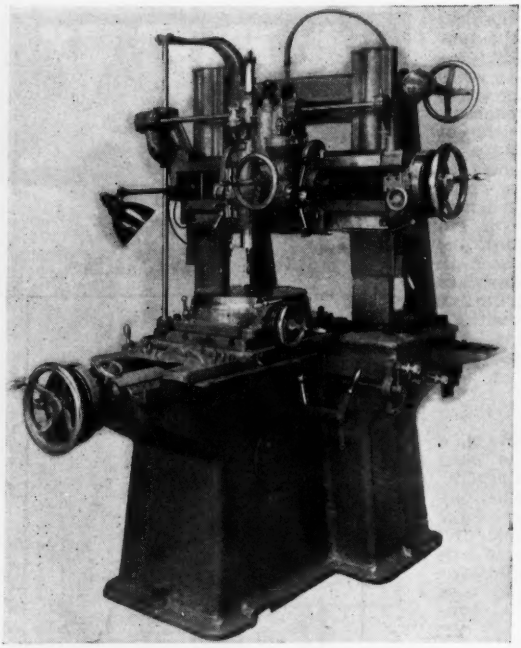

Fig. 1—Hauser No. 3½ Jig Boring Machine

High Precision Jig Boring Machine

The Index Machinery Corporation, 49 Central Avenue, Cincinnati, Ohio, is announcing the introduction of an improved No. 3½ Hauser Jig Boring Machine. Built by Henri Hauser Company of Bienne, Switzerland, this machine is said to carry many features which are decidedly new in jig boring equipment.

The most noteworthy among these new features is a patented method of insuring absolute alignment between the boring spindle and the work table, as shown in Fig. 2. This alignment is established and maintained by equipping the cross-rail with hardened, ground and lapped locating plungers that rest on hardened, ground and lapped locating blocks which are mounted on the sturdy housing members of the machine. The bearing contact is made at the outer end of the cross-rail, and since no wear takes place thru this method of locating the cross-rail and no weight is suspended on the elevating screws, absolute alignment between the spindle and work table results.

Other outstanding features are the large micrometer reading wheels for quick, accurate setting; forced pump lubrication of the boring spindle; automatic reversible feeds, general massive construction and central control.

The working surface of the table of the machine is 26 x 16 in. and the spindle speeds range from 50 to 1500 r.p.m. The maximum boring capacity is 4 in. and by the use of a high speed drilling and boring attachment with 3000 r.p.m. spindle speeds, the smallest holes may be drilled or bored accurately and economically.

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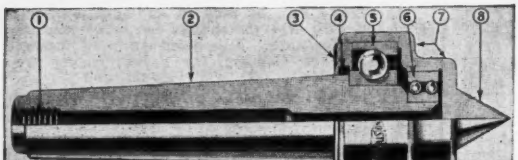

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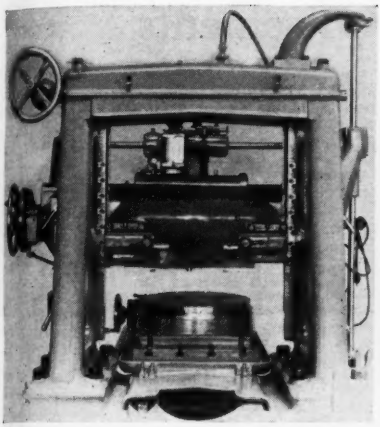
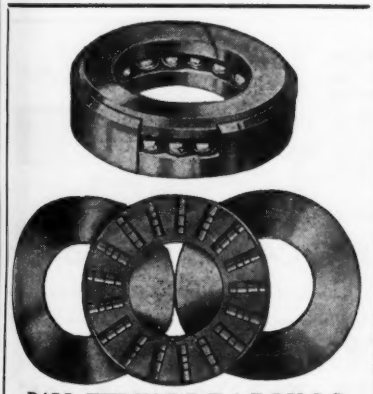


Fig 2—Alignment of boring spindle and work table is maintained by locating plungers, resting on locating blocks on the housing members.

lar tables as well as many other special attachments are available to greatly increase the utility of this machine.



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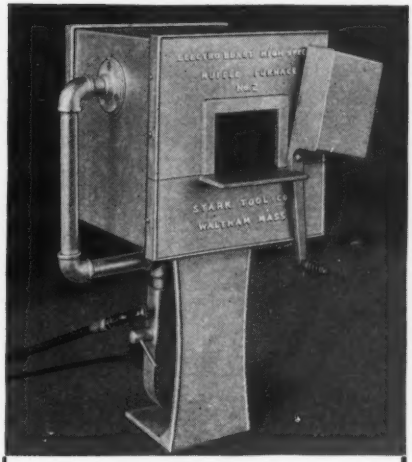

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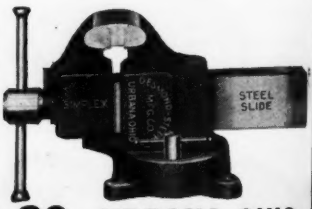

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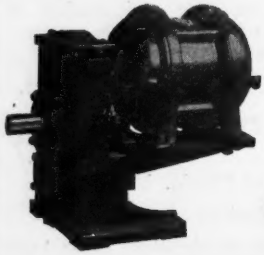

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